The FOUNDRY

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How Ford Cylinder Blocks Are Cast

New River Rouge Plant Built on Stupendous Scale and Operated on the Continuous Production Principle — Conveyors Expedite Handling of Materials and Product

BY PAT DWYER

LARGE figures, when set down as the enumeration of quantity, rarely convey to the readers mind a concrete idea of the total involved. Whether it is one, two, three or a hundred millions, the impression produced practically is the same. The number is too large to be grasped readily and it becomes necessary to provide some method of comparison—some tangible, comparative unit of measurement on which to focus attention and gradually lead up to the total number.

The statement that approximately 2,000,000 automobiles are produced annually in the United States means nothing insofar as producing a definite impression is concerned but when the statement is amplified to the effect that it means one automobile made each year for every 55 inhabitants of the country, the statement makes an impression. The mind secures a firmer grasp on the idea when it is learned that the Ford Motor Co. is responsible for the production of over 1,000,000 cars a year, or more than one half of the total output, yet a more detailed statement is required before the average man can realize just what a million cars a year actually means.

The output of the Ford shops has averaged 4000 cars a day for over two years and recently this has been increased to 4500. Some departments operate 8 hours a day, some 16 hours and a few on 24 hours schedule. If the entire plant were regarded as working 24 hours a day or 1440 minutes, it readily would be apparent that a car is completed in the almost unbelievable time of 0.32 minute. To express it another way, the cars are rolled out of the factory at the rate of three a minute 24 hours a day, 300 days a year. This tremendous output has been accomplished at the Highland Park plant of the company and would seem to be the summit of human achievement for such a stupendous production seems to be something impossible to maintain either in manufacture or distribution. But an entirely new plant including a foundry is almost completed at River Rouge on the eastern outskirts of Detroit in which it is proposed to manufacture the castings for 8000 cars a day in addition to a large tonnage of castings for tractors. Furthermore, as indicating the scope of the companys' ambition, the plans provide for expansion even of this mammoth plant to twice its indicated size and capacity.

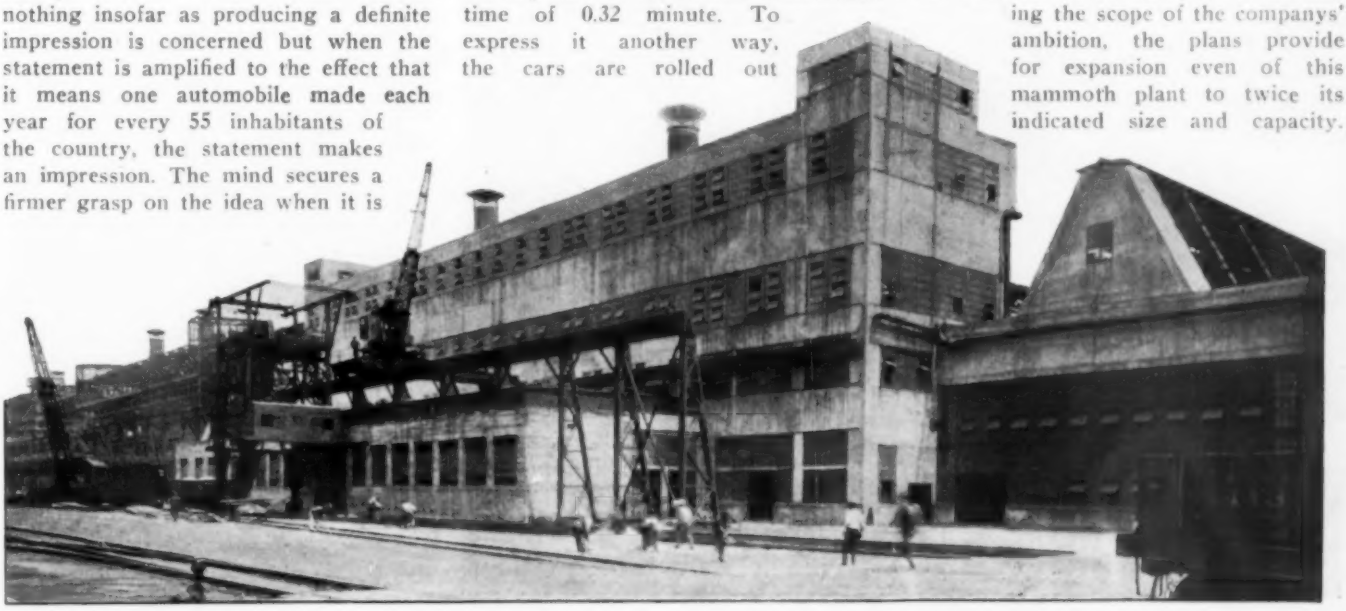


FIG. 1—THE THREE UNITS OF THE CUPOLA BUILDING OF THE NEW FORD MOTOR CO. FOUNDRY, RIVER ROUGE, MICH. THE UNIT TO THE RIGHT IS COMPLETE

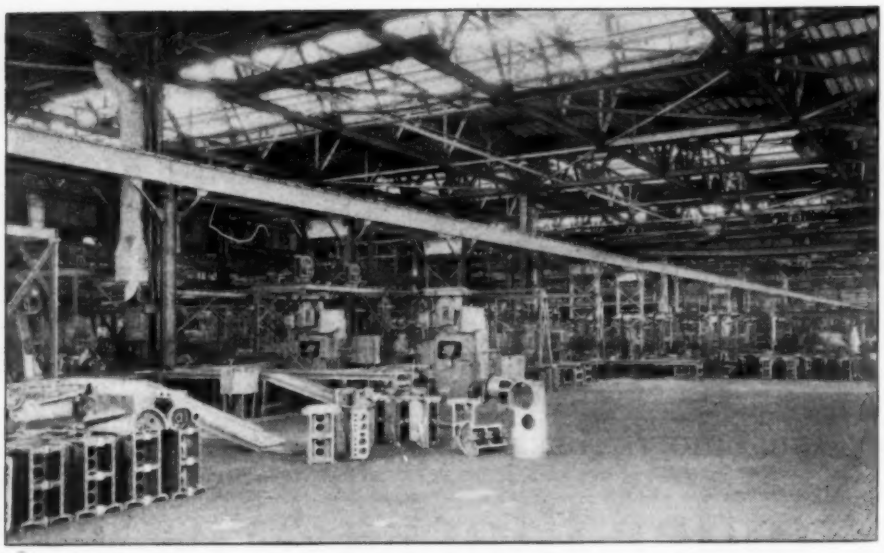


FIG. 2—A VIEW OF THE MACHINE SHOP SHOWING THE CLOSE GROUPING OF THE MACHINES

The River Rouge plant, which eventually will comprise eight 450-ton blast furnaces, a sufficient number of batteries of by-product coke ovens to supply them with coke, steelmaking furnaces, rolling mills, foundries, machine shops and assembling plants, is being placed in operation as fast as the different units are completed. A number of coke ovens together with the necessary building and apparatus for the recovery of the by-products already are in operation. Two blast furnaces have been completed and one of them has been making iron for some time. A certain amount of the iron is taken directly to the foundry where it is mixed with the cupola iron; the remainder is taken to a modern pig casting machine. The method adopted for utilizing the blast furnace iron in the foundry will be touched upon more in detail later.

The foundry building proper, 1188 x 660 feet, required 8000 tons of structural steel. A continuous steel sash encircles two sides and one end. The other end is built of brick with four large doors and several windows. It is divided into 18 bays by columns spaced on 66-foot centers both ways and 27 feet high in the clear under the roof trusses. It is lighted by 18 lantern frames on the roof with the gable ends on the long sides of the foundry. Incandescent lights furnish illumination for night work. The inside equipment, comprising elevators, conveyors, etc., consumed another 8000 tons of structural steel. The cupola building, four stories high, which adjoins and parallels the foundry building all along one side, required 9000 tons of steel in its construction.

FIG. 3—ONE OF THE UNITS OF THE FOUNDRY BUILDING AS IT APPEARED DURING CONSTRUCTION

The floor, made up of wood blocks laid on concrete, is divided into two main sections by a wide gangway extending longitudinally in the center from one end of the building to the other. The floor on one side of the gangway is devoted to shaking out, cleaning, testing and shipping the castings. The other side is divided into eight units devoted to molding, core making and pouring castings. The sand for the molders and coremakers is reconditioned in a set of mixers and hoppers situated over the gangway and taken back to the molding machines and coremaker's benches by an overhead conveyor which discharges into hoppers provided with hand controlled gates over each workman's station.

Perhaps the best method of gaining an intelligent idea of how this immense foundry functions, how the vast quantities of material are handled and how the integral parts of each unit are co-ordinated and synchronized to produce an uninterrupted flow of castings day and night, is to study the regular sequence of operation, core making, molding, pouring, melting and cleaning, and to consider each in detail. As a preliminary, it may be stated that the equipment for the entire foundry is not yet installed and some of the later conveyors will differ in detail to meet peculiar conditions incident to the class of castings to be handled, but in the main the following description will cover each of the units.

The entire foundry may be considered as a unit, inasmuch as through an elastic monorail system iron may be delivered from any cupola to any of the pouring stands and also, because the iron entering into the charge is delivered on a continuous charging floor and may be deflected to any of the cupolas. Still in practice, the foundry is divided into a number of self-contained units which may function individually. Similarly, although four batteries of core ovens are provided, each battery designed to serve two molding units, in an emergency the cores may be conveyed to any point in the foundry. From the foregoing it will be apparent readily that although the foundry is under one roof, it really comprises eight fully equipped foundries each one operating on a special line of castings. For the same reason, a detailed description of one unit may be regarded as typical of and serve as an illustration of all.

With the exception of the molding machines, motors and possibly some minor pieces of equipment the Ford company, designed, constructed and installed all the conveyors and sand-handling apparatus to meet its special requirements. A considerable part of the equipment is modeled on that used in the Highland Park plant and the changes in the remainder are in line with the companys' policy of ever seeking means to increase production. If a contemplated change will result in more economical operation, well and good; but the dominant aim and object of the Ford organization is increased output.

At present the new sand for the cores is hauled in from the yard in a dumping pan drawn by a gasoline truck. Eventually it is proposed to bring it in on a belt conveyor. From the pan it is dumped through a grating in the floor of the gangway. A bucket elevator conveys it to a hopper located above a mezzanine floor which extends over the coremaker's stations at one side of the gangway and over the batteries of tumbling barrels on the other side. The floor extending over the tumbling barrels is utilized for knocking the cores out of the castings. It is provided with gratings through which the spent core sand drops onto a belt conveyor which discharges into a breaker and magnetic separator which removes the scrap from the sand. From the magnetic separator, the sand is taken by an elevator to a hopper adjoining that in which the new sand is stored. Both hoppers are provided with bottom-discharge spouts equipped with hand-operated gates through which the requisite amount is measured into a box and then together with the necessary amount of binder is conveyed to a mixing machine of the worm type. Water is added at this point and after a predetermined number of revolutions, the prepared sand is discharged into a dumping pan which is hauled by hand to the openings of the spouts leading to the coremaker's stations and discharged.

The water-jacket cores, port cores and valve housings are made of all new sand bonded with an oil binder made to special formulas for the Ford company. The large body cores carrying the barrels are made from a mixture of old and new sand in the proportion of approximately 3 to 1 depending on local conditions, such as the amount of old sand available, and bonded with a pitch compound made to Ford specifications. The sand is mixed in the proportion of 1½ parts of compound to 20 parts of sand. It is claimed that a higher percentage of sand would make satisfactory cores under ordinary circumstances, but on account of local conditions, breaking in new men, rough usage, etc., it is the part of economy to use more binder.

The well-known Ford plan of intensive production by assigning one job to one man is exemplified in a striking manner in the coreroom, a number of circular steel plates mounted about waist high under the sand chutes are employed as benches on which to make the greater part of the cores. Usually five workmen are stationed at each table. The first man places a certain amount of sand in the box, he then pushes the box to the second who sets the wires and passes the box to the third, who places the remainder of sand in the box and sets the vent wires. The fourth rams it and passes it to the fifth who removes the vent wires and turns the core into a dryer. In this manner a constant stream of cores is kept moving around the table. Another workman does nothing but lift the finished cores off the table and place them on a pendulum conveyor which takes them to a revolving stand at which a workman stationed with a spray nozzle coats them with blacking. An additional workman, standing by the the blacking stand lifts the core and places it on a suspended core rack which travels down one side of the oven and up the other. When the cores emerge they are perfectly dry and are lifted off and placed on a wooden-top belt conveyor operating between two ovens. This conveyor delivers the cores to the assembling and inspection department which occupies the entire space between two molding units. From this point the cores are conveyed by spring barrows to the men who place them in the molds.

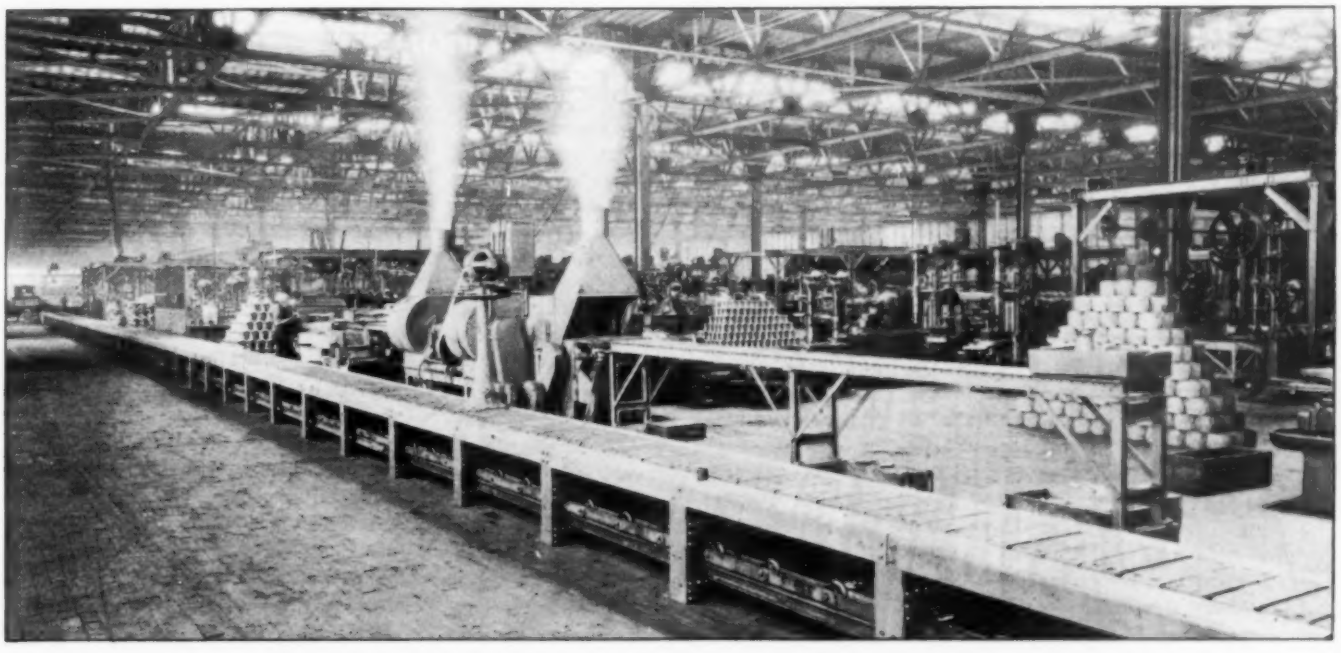


FIG. 4—ANOTHER VIEW OF THE MACHINE SHOP. IN THE FOREGROUND IS THE BELT CONVEYOR FOR HANDLING RAW AND FINISHED STOCK

Some of the valve-housing cores are made on tables provided with vibrator attachments and it is interesting to note that they weigh several ounces less than cores produced on benches that are not equipped in this manner. Each gang of five men makes 675 valve-housing cores a day, a similar gang of four men makes 675 water-jacket cores. Men working individually make the port cores at the rate of 495 a day and others make the large

body cores at the rate of 165 a day.

The body core is made in two parts with two barrels attached to each section. This division has been adopted to facilitate making, drying and placing the core in the mold. The only reinforcement used in the core consists of a length of 1¼-inch steel pipe extending through the center of each barrel from end to end. The pipe is freely perforated with ¼-inch holes and that is all the venting the core receives. The pipe arbors for the body cores are brought down from the knock-out floor on trucks and one man does nothing but dip them in a vat of thin paste. A second man distributes them to the workman ramming the body cores.

Making the Body Core

The corebox, made of cast iron accurately machined and finished, is made up of a base and four loose sides. The sides are assembled on the base barrel end down and are held in place by four screw clamps. The operator sets the two pipe arbors which automatically center themselves in the base. He then releases the gate in the sand chute and allows a sufficient quantity of sand to flow into the box to fill it to the top. He uses a rammer consisting of a narrow eliptical ring attached by two uprights to a handle, to ram the sand around the arbors. He shovels enough sand off the floor to complete the operation and butts it off with a short hand rammer. He uses a short steel straight edge to scrape the surface flush and then removes a ½-inch steel rod from the center of each arbor. These rods are placed in the pipes before any sand is introduced into the box. The lower ends of the pipes are partly closed and the rods serve the double purpose of helping to center the pipes and insure a clear vent through the holes in the ends. The upper ends of the pipes are open and a certain amount of sand falls into them during the ramming operation. After the core has been rammed, the box is laid on its side. Then a small iron plate is placed against the large end and the box is inverted from its original position. At this stage the clamps are removed and the side plates are taken away one at a time and reassembled on the ramming stand for another core. A second workman inserts the points of a piece of wire bent in the shape of a U into the openings in the ends of the pipe arbors to prevent the barrels from sagging out of shape while the core is green. This job requires keen judgment, for if the wire pinches tightly, it will pull the barrels together, while if it is loose, the barrels will sag apart. The holes in the ends of the barrels are not machined and therefore are not an absolutely uniform distance apart, hence the workman is compelled to adjust the wires by the sense of touch.

The coremaker who inserts the wires also tools any minor irreguarities on the core and then with a pair of special hand clips places it on the conveyor which takes it to the blacking stand. The upper end of the pipe section supporting the conveyor shelf is provided with a spiral spring which minimizes vibration on the journey.

The core ovens, each 50 x 13 feet 6 inches, are of the continuous type and are built in batteries of four as indicated in Figs. 5 and 6. It will be noted that the two outside ovens are separated from the two in the center by narrow passages. A tunnel under the floor between the ovens houses the gas mains while the continuous type of conveyor shown is above the floor and serves to convey the dried cores to the storage and inspection department. The ovens are heated by coke-oven gas. Air under pressure is introduced to the gas mains through a suitable mixing mechanism at the back of the central ovens. Two 6-inch gas mains are laid in each tunnel and these in turn feed a number of 3-inch burners pierced with ⅛-inch holes in a straight line on the top side of the burners. The burners extending from side to side of the ovens are laid 2 feet apart on the floor and each one is provided with an adjusting valve at the point where it joins the feed pipe. Each main also is provided with a shutoff valve and by an intelligent manipulation of these various valves, the temperature may be controlled to a nicety. A recording pyrometer attached to each oven keeps the oven tender posted on firing conditions. It is claimed that after the valves have been adjusted the ovens will run uniformly for hours.

Cores Dried Quickly

Core ovens of the continuous type are provided with cages suspended from an overhead trolley. Each cage makes a complete revolution of the ovens in which 1500 large cores are dried in two hours and in the ovens in which 2000 smaller cores are dried in one hour. To prevent any loss of heat hrough the openings in the end of the oven where the cages enter and come out, each cage is provided at each end with a plate the full height and width of the opening. The entrance and exit of each oven is built in the shape of a short vestibule and consequently each core cage effectively fills the opening on its way through, either into or out of the oven. Suction fans draw the smoke and steam out of the ovens and discharge into suitable stacks leading through the roof.

The molds for the cylinder blocks are made in green sand on two batteries of molding machines made by Henry H. Pridmore, Chicago, one battery on each side of a drag-type conveyor as shown in Figs. 5 and 6. It will be noted that the outside conveyors travel toward the pouring stations while the center conveyor moves toward the shake out station as indicated by the arrows. Each conveyor is driven by an individual 10-horsepower motor manufactured by the Westinghouse Electric & Mfg. Co., Pittsburgh, and is connected through a set of reduction gears to a picker belt chain provided with fingers at regular intervals which engage one of the cleats on the bottom boards of the flasks. The group of men making the molds is spread out in a long line on both sides of the conveyor, but as one side is an exact duplicate of the other a description of the method employed on one side will serve for both.

Making the Molds

The drags are rammed by hand on a battery of six rollover, pattern-draw machines with three men to each machine. Each man has a definite number of motions to make, but they alternate at intervals during the day to distribute the burden in an equitable manner. Each molding machine is placed directly under a sand chute and is filled by opening a gate within easy reach of one of the operators. Two men ram the flask and lift it on and off the machine. The third does what little necessary finishing is required and brushes blacking over the face, then with the aid of one of his companions, he sets the drag on the conveyor.

Once on the conveyor the drag passes along before a number of men each of whom contributes his quota toward a complete mold. The first sets the housing and port cores, the second tries a gage on these cores and then sets the gear case core; the third blows a jet of air through the mold to clean it out and then sets the housing core chaplets. The next sets and gages the water jacket core and the following workman sets the body or barrel cores and by small checks tallies the number of molds as they go by. Each molding machine bears an individual number and in this manner a check is kept on the output of each one. The last man in the group tries an overall gage on the cores and by that time the mold has arrived in front of the cope machines.

The copes are hand rammed on a

battery of six stripping plate machines by three men on each machine. After throwing a handful of facing over the pattern, one man sets a 5-inch spike in each hanging pocket while the second sets the runner core and gate pin on the center of the back flange. The runner core is merely a small block of sand about 1-inch thick with an oblong hole through the center and rests upon a small lug on the pattern provided for that purpose. In this manner no danger exists for the gate pin to shift under the influence of the rammer and also there is no danger of the gate edges washing away under the force of the falling stream of iron. This method of pouring a cylinder block through one small pop gate directly above the bottom of the completed casting is radically different from the elaborate pouring and gating systems in vogue in other foundries which handle this class of work. That it is satisfactory is evidenced by the fact that it has been in use for years by this company and it is claimed that the cylinder losses from all causes average below 10 per cent.

Sequence of Operation

After the gate pin is pulled out of the rammed cope, one of the men sprinkles a little blacking around the hole and then drops a tapered mushroom-shaped plug in the hole and gives it a turn. This reams out and smoothes the top of the sprue. The castings are poured without risers. The copes are placed on a platform alongside the conveyor as they are made and two men walk back and forth setting them on the drags. Long pins extending through upper and lower lugs on the cope flask ends are employed for guiding the copes into place on the drag flasks. The pins are not removed until after the mold has been poured and is on its way back on the center conveyor.

Removing the Clamps

A man standing between the inside and outside conveyors knocks the clamps off the poured molds as they return toward the shake-out and places them within reach of a second man who lays four on top of each freshly closed mold. This man also sets the back plate up against the open side of the flask. A third man places a piece of paper over the sprue then sets a runner box and four wedges on top of the cope. Two men clamp the flasks. The two clamps on the outside in addition to holding the cope and drag together also hold the back plate firmly in place. For the benefit of those not ac-

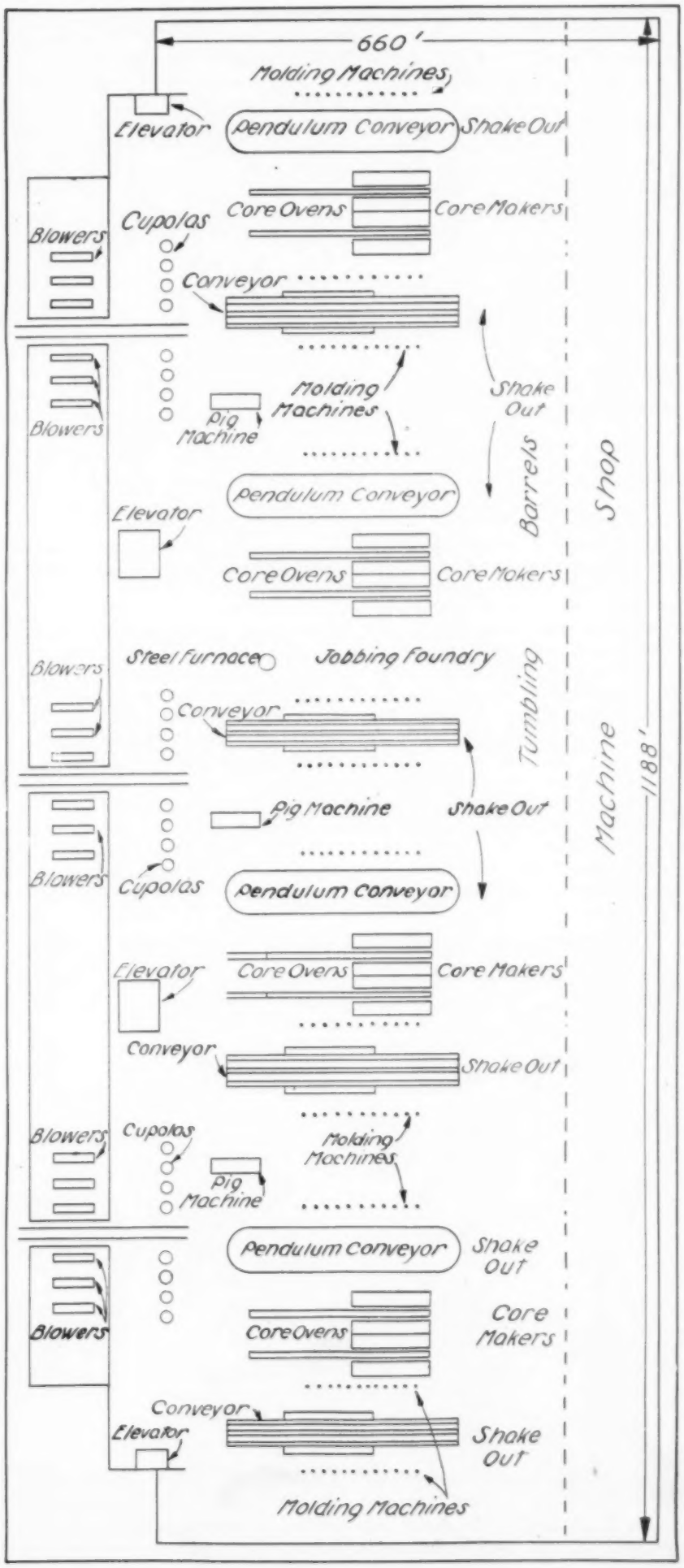


FIG. 5—GENERAL LAYOUT OF RIVER ROUGE FOUNDRY IN WHICH WILL BE MADE CASTINGS FOR 8000 CARS A DAY IN ADDITION TO TRACTOR CASTINGS

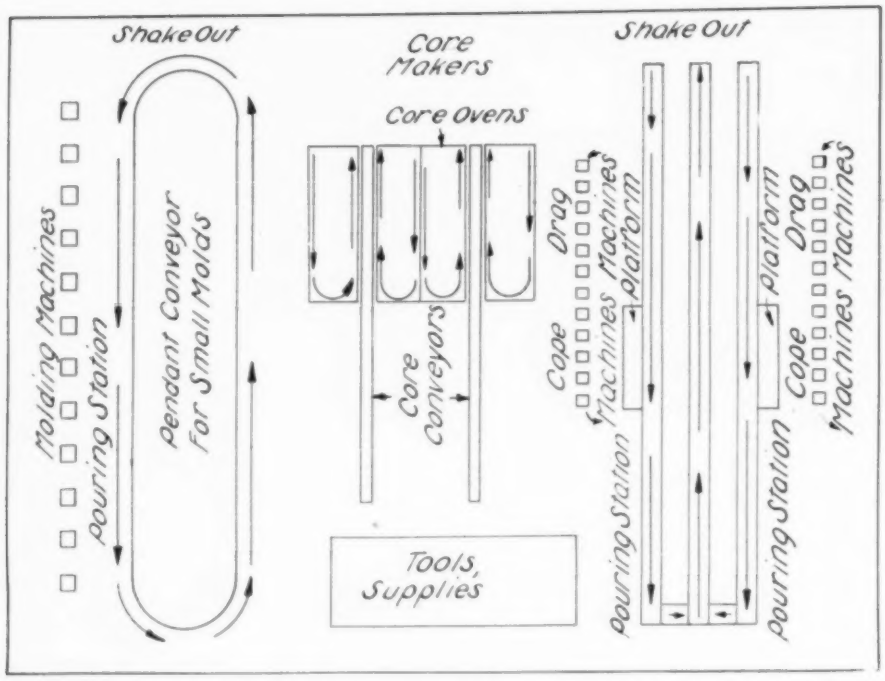


FIG. 6—DETAILED LAYOUT OF ONE OF THE FOUR FOUNDRY UNITS OF THE NEW PLANT

quainted with the Ford cylinder, it may be stated that one side of the cope and drag in which it is molded is cut out the full size of the rectangular body core print. This method was adopted to facilitate setting the body cores in the mold, but these cores do not fit tightly enough to prevent iron from leaking through and therefore it is necessary to set a flat plate across the opening after the mold is closed and pack the space between the end of the core and the plate with sand.

Pouring the Castings

One man throws a few shovels of sand into the space between the back plate and the core and a second rams it. Two men ram the runner boxes. One man sets an iron block provided with a handle in the center of the box and rams the sand which the other shovels in. No attempt is made to slick around the top of the runner, the workman simply pulls out the block and sets it in the next runner box. A workman, provided with an air hose, blows all the loose sand out of the runner and then the mold is ready for the iron. The iron, which is melted extremely hot is brought from the cupolas in 1-ton ladles hanging from chain blocks made by the Yale & Towne Mfg. Co., Stamford, Conn., and suspended from a 12-inch I-beam monorail. One man operates the chain hoist and a second operates the geared ladle.

After the molds are poured they travel to the end of the conveyor where a double pneumatic device operated by two men pushes the molds from each of the outside conveyors onto the center conveyor. The center conveyor, as indicated by the arrows in Fig 6, travels in the opposite direction to the outside conveyors and carries the molds to the shake-out station. The center conveyor is covered by a sheet-iron hood and travels over a grating through which all the smoke and gases are exhausted by a powerful suction fan and discharged through stacks extending above the roof.

The flasks are shaken out over a grating in the floor at the end of the conveyor and then placed on the outside conveyors which take them back to the molding stations. The castings are loaded into iron pans and by means of a 5-ton crane manufactured by the Milwaukee Electric Crane & Mfg. Co., Milwaukee, are taken to the second floor which as already intimated extends back from and over the center gangway. Here they are allowed to cool before the cores are knocked out. However, as the supply constantly is arriving and as constantly departing, it is obvious that a sufficient supply of cold castings always is available. In the second molding unit, the castings are taken to the second floor on an endless conveyor, but sufficient data are not yet available to determine which is the more economical method.

Cleaning the Castings

From the pans the castings are lifted onto a stand where two men provided with long pneumatic hammers punch out the barrel core arbors. The castings then are pushed onto a pair of parallel rails resting on a grating and other workmen with sharp bars remove almost all of the core sand which falls through the grating into a revolving riddle that reclaims the greater portion of it. The castings then are loaded on trucks and taken down on a 3½-ton elevator to the ground floor and loaded into one of the myriad of tumbling barrels. From the tumbling barrels the castings are taken by trucks to the chipping stands which also are arranged on the continuous system. A row of men stands alongside each stand and each chips his allotted part of the casting and then pushes it on to the workman at his right. From the chipping stands, the castings are loaded onto trucks and after three or four trucks are loaded, a gasoline tractor is hitched on and hauls them to the shipping platform outside the building. The machine shop at the River Rouge plant is not yet in operation and therefore all the castings are taken to the Highland Park plant of the company for testing and assembling.

Mixing the Sand

The sand from the shake-out floor falls through a grating into a hopper from which it is lifted by a bucket elevator and discharged into a revolving screen set at a slight angle and provided with openings at each end. The sand enters at one end and the centrifugal force throws all the scrap and hard lumps out through the other end. The sand passes through a beater which reduces it to the proper temper and then it is discharged upon a conveyor of the scraper type operating over the chutes leading to the various molding machine stations. A heavy steel bar suspended at the point where the scraper blades start on their horizontal journey is lifted by each blade passing under it. As the blade passes from under the bar the latter swings back and strikes the succeeding blade a sharp blow which effectually loosens any adhering sand. A gate is provided over each chute by which the supply of sand may be cut off at any time from any individual machine.

Gratings are provided in the floor in the vicinity of each machine through which the surplus sand is shoveled onto a belt conveyor which takes it to the mixing station and incorporates it with the sand from the shake-out floor. Any sand left in the overhead conveyor after it has passed the various chutes is discharged over the end onto the floor. It is allowed to accumulate for a while and then is shoveled through a grating onto the conveyor belt already mentioned.

A small portion is retained and in conjunction with a little new sand and coal dust is passed through a paddle-type mixer and used for facing sand. A similar system is provided for reclaiming the spilled sand in the core-making department.

The light work conveyor shown at the left of Fig. 6 is equipped with 12 molding machines supplied by the Berkshire Molding Machine Co., Cleveland, but has not been placed in operation up to the present. No. 2 cylinder molding unit is equipped in a similar manner to No. 1 with the exception of the conveyor for the castings already mentioned. Another point of difference is that one of the sand throwing machines made by Beardsley & Piper, Chicago, has been installed for making the copes of the cylinder molds. The drags are made of six rollover, pattern-draw machines also made by Henry E. Pridmore, Chicago, as in No. 1 unit. Data are not yet available on the comparative merits of the two systems. In this connection it is interesting to note that the production on No. 1 unit is approximately 2400 cylinder blocks on each 8-hour shift and it is expected that this production eventually will reach 3000.

Melting Equipment

The immense tonnage contemplated in this big foundry may be gaged from the fact that 24 cupolas, each with a 78-inch shell lined to 60-inch diameter will be erected. They will be arranged in three groups of eight of which the first group already is in operation. The entire number will be provided by the Whiting Corp., Harvey, Ill. The exterior of the cupola building, comprising three units is shown in Fig. 1 with the first unit complete. The two stacks shown above the roof serve eight cupolas, four to a stack. The shells of the cupola extend upward only to the fourth floor where each group of four discharges smoke, gas and sparks into a large steel muffle chamber. The gases pass off quietly through one of the stacks shown extending above the roof.

A wide plate continuous conveyor, running flush with the fourth floor, deposits coke and limestone in a number of bins suspended between the fourth and the third floors. The discharge ends of these bins or hoppers are within easy reaching distance of the men on the third floor and are located directly above a narrow-gage track upon which the coke buggies are pushed back and forth. Two charging chutes, one on each side, are employed to convey the greater part of the charge into each cupola. The tops of the chutes extend above the third floor and are located between two narrow-gage tracks while the discharge ends open into the cupola a little above the second floor level.

Scrap, sprues and defective castings are loaded into dumping trucks and taken to the third floor on two 3½-ton elevators. From the elevators they are pushed over the chute openings and dumped. Coming into the cupola from both sides helps to distribute the charge in a fairly uniform manner. Additions of steel, foreign scrap and a limited amount of pig iron are charged by hand in the usual manner through a doorway located just above the second floor; or what corresponds to the regular charging floor in most foundries. An elevated passageway, located above the floor between two molding units connects the floor on which the castings receive their preliminary cleaning with the second floor in the cupola room. All the scrap from the shake-out floor and cleaning floor is conveyed across this passageway in dumping pans running on narrow-gage tracks.

Blast Furnace Iron

A popular misconception among the reading public due in large measure to newspaper reports written by non-technical writers is that the castings in this plant are all poured directly from blast furnace metal. In fact, the original intention was to mix the iron in the proportion of 50 per cent domestic and foreign scrap and the remaining 50 per cent pig iron. The scrap was to be melted in the cupola and the pig iron supplied from the blast furnace in a molten condition. However, in practice, due partly to the silicon content of the blast furnace iron varying from time to time and due in a greater extent to the fact that the iron must be poured at an exceedingly high temperature, the amount of furnace metal varies from

FIG. 7—THE CUPOLA BUILDING AND ONE SIDE OF THE FOUNDRY BUILDING WHILE IN THE PROCESS OF CONSTRUCTION

33 to 50 per cent of the total mixture. The blast furnace is tapped every four hours commencing at 7 a. m. and at each tap, one ladle of metal is taken to the cupolas. The remainder is taken to a pig casting machine.

The ladle of iron mounted on standard gage trucks is shunted under a ladle tipping device shown at the top and center of Fig. 1, made by the Wellman-Seaver-Morgan Co., Cleveland. Here the iron is transferred to a brick-lined steel container mounted on a truck running on a standard-gage track extending through the cupola building from side to side and terminating at a point under a monorail and in line with the ends of the battery of eight cupola spouts four on each side. The container is completely inclosed with the exception of a round hole on top near the back and a second opening near the top in front which serves as a spout through which the iron is poured into the 1-ton ladles used to pour the castings. After the iron is poured into the container, the hole on top is covered with a brick lined lid to help maintain the temperature of the iron. A man stationed in a cage suspended from the beams close to and in front of the monorail, operates an electric hoist which raises the back of the container and permits the iron to run into the ladle suspended from the monorail in front of the spout.

A 2-foot section of the monorail in front of the container and a similar section in front of each cupola is supported independently on a scale which registers on a large, easily read dial the amount of iron going into the ladle. In this manner the relative amount of direct and cupola metal going into each ladle easily is controlled. The silicon content of the metal in the ladle is set at 2.64 per cent. The metal from the blast furnace ranges from 2.50 to 3.50 per cent. The analysis of each ladle of blast furnace metal is received at the foundry shortly after the iron has been tapped and the cupola charge is adjusted to meet the desired conditions. As stated before, the temperature of the blast furnace metal is a factor to be considered. When it is quite hot a correspondingly less amount of cupola metal will be required to bring it to a proper pouring temperature than when it is cold. The required amount of direct metal is poured into the ladle first, then the ladle is placed in front of the cupola spout and the remainder of the metal tapped into it. A small handful of aluminum is thrown into the ladle while the cupola stream is running. It is claimed that this treatment deoxidizes the metal and renders it more fluid. From the cupola the metal is conveyed on a monorail to the various pouring stations and poured into the molds.

A small pig casting machine has been erected in the open space in front of the cupolas into which any cold iron left in the ladles is poured. At present three cupolas, melting 75 tons each, are used on the shift from 7 a. m. to 3 p. m. and one cupola melting 90 tons is used on the shift starting at 3 p. m. when only one molding unit is in operation. The three cupolas used during the day are picked out, daubed and made ready at night for the following day's run. The cupola used during the night is made ready during the day preceding. The other cupolas in the battery are all bricked up and held as spares.

Iron and Fuel Ratio

On account of the exceedingly hot iron required and the length of time the cupolas are in blast, it has been found advisable to use both upper and lower tuyeres. This practice necessitates a high coke bed, in this case 44 inches above the lower tuyeres. However, considering the amount of iron melted during each heat, the extra amount of coke used in the bed becomes a negligible factor. The succeeding charges are made up in the proportion of 400 pounds of coke to 2400 pounds of iron or a ratio of 1 to 6.

Blast is furnished each cupola at 14 ounces by a positive pressure blower supplied by the B. F. Sturtevant Co., Boston, driven by a 75-horsepower motor. These blowers discharge into a common main and the blast may be diverted from one cupola to another. The blowers are housed in the small building shown attached to the main cupola building in Fig. 5. Part of this building is devoted to daubing the ladles and is provided with the necessary supplies and appliances for this purpose. The flat roof is inclosed by a steel curbing 4 feet high and is provided with a number of bins holding steel and iron scrap and pig iron of various compositions. About 10 per cent steel scrap is used in each charge and the pig iron is used in varying amounts depending on the chemical content of the blast furnace iron. Slag from the cupolas runs directly into 4-wheeled iron trucks, which when filled, are hauled to one of the elevators and taken to the second floor. Here they are taken out on the roof of the blower building and allowed to cool. Afterward the slag is dumped through a chute into a waiting railroad car. The ladle tipping device shown in the same illustration is mounted on a special wide-gage track and is available for use at any one of the three batteries of cupolas.

The bay between two rows of columns as indicated in Fig. 5 has been set apart and fitted up as a jobbing foundry for the manufacture of a miscellaneous line of castings ranging in size and weight from washers to blast furnace slag ladles. The equipment includes among other items a concrete lined casting pit 16 feet square and a 10-ton electric traveling crane. An electric furnace made by the Electric Furnace Construction Co., Philadelphia, is installed near one end of the bay and will be utilized to furnish the metal for the steel castings.

During the erection of the building and during the erection and installation of the equipment the company maintained a fully equipped machine shop, structural steel shop and sheet iron and tin shop on the premises.

The tools and equipment necessary for the fabrication and erection were not attached to permanent foundations. They were first placed near the center of the building and moved along as the work progressed.

British Foundrymen Hold Postponed Meeting

The postponed meeting of the Institution of British Foundrymen, held at Blackpool, a seaside resort near Manchester, Sept. 13 to 16, marked the inauguration of closer contact in technical discussion and an even more cordial relationship between the British society and the American Foundrymen's association. In accordance with an arrangement made last year, a paper contributed by an American foundryman was read and discussed. This paper, "The Basic Hearth Electric Furnace and Some Problems of Cast Iron," by George K. Elliott, Lunkenheimer Co., Cincinnati, was presented in the Sept. 15 issue of THE FOUNDRY. Its presentation abroad was enthusiastically received. The secretary, on behalf of the officers and council members cabled an expression of appreciation to C. E. Hoyt, secretary of the American association.

The new president of the Institution, Oliver Stubbs, Joseph Stubbs, Ltd., Manchester was installed at the business session held Wednesday morning, Sept. 14. The other officers of the British foundry society are H. L. Reason, Birmingham, senior vice president, H. Jewson, East Dereham, junior vice president, both newly elected and William G. Hollinworth, London, secretary, F. W. Finch, treasurer, who were re-elected to the offices which they have held for a number of years.

Discusses Problems of the Foundry

Differing View of Metallurgists Regarding the Effect of Oxygen in Gray Iron Are Discussed—Methods of Making Physical Tests and Their Effects on the Results Are Pointed Out

BY J. SHAW

IT IS difficult to reconcile the various views put forward by authors concerning some phase of our work. Reference was made last year in Professor Andrews' paper to the bad effect of oxide inclusions in cast iron. This year George H. Elliot mentions the same fact. Yet some eminent metallurgists deny that any oxide can be present in an iron containing over 0.3 per cent of silicon, while others again state that oxide is beneficial to the iron and actually blow air into the metal to improve its quality.

Pickard in his Carnegie Research (page 76, Carnegie Memoirs, 1916), states: "The chief interest attaching to the results is that they show that oxygen is present in material from which it has usually been assumed to be absent; and that an amount of oxygen which would be important if found in steel may exist in material containing even such comparatively large amounts of silicon as commercial cast iron."

Dr. Hadfield has given it as his opinion that if iron contains more than 0.3 per cent silicon it is free from oxide. A liquid iron containing 1.3 per cent silicon, 1 per cent phosphorus and 0.6 per cent manganese is one which J. E. Johnson Jr., said might contain oxygen. But Dr. Hadfield said quite definitely such iron could not contain oxygen, because the silicon, phosphorus, and the manganese had a much greater affinity for oxygen than the iron in which they were dissolved, and the result was that, before the oxygen could form oxide of iron and so be dissolved in the iron, it would form oxides of those elements, which would come to the surface, and so be eliminated from the iron, by specific gravity alone.

Claims Oxides Exist in Iron

Elliot's view, that oxides do exist in cast iron in appreciable quantities, but that their action is detrimental, is held by many people, including P. Munnock (B. F. A. Proceedings, 1908), Houghton (B. F. A. Proceedings, 1908, page 44), Professor J. Porter (FOUNDRY, October, 1912) and Dr. Moldenke (Principles of Iron Founding). The last authority states, "This problem can undoubtedly be traced back into the blast furnace. It is perfectly possible that the difference between a pig iron, which shows superior strength on being broken and another of the same composition, which breaks readily, lies simply in the percentage of oxygen retained in passing through the reduction from ore to metal, or more likely in a slight re-oxidation of the melted iron sponge as it passes by the tuyere zone of the blast furnace.

Determined Oxygen Quantitatively

"When it is remembered that with apparently identical compositions, there are definite qualities inherent in various brands of cold-blast and warm-blast charcoal irons, as also in hot blast coke irons, which manifest themselves in greater or less strength, machinability and fineness of structive, there must be a reason for this situation other than a mysterious agency or heredity ore qualities transmitted to the pig iron (the view still held by many old-time furnace and foundrymen). This reason the author has for many years claimed to be the extremely small percentages of dissolved iron oxides in the several classes of pig iron in question."

J. E. Johnson Jr., (American Foundrymen's association proceedings, 1914) and Wilford L. Stork (Foundry Trade Journal, July, 1919), go a step further and state that oxide not only can exist in iron containing 1.88 per cent silicon, but that its effect is beneficial.

Johnson states: "In the course of an investigation extending over two years and carried on by means of physical tests, remelts, photomicrographs, and direct determinations of oxygen, we found that all abnormally good irons contained oxygen to the extent of 0.04 to 0.10 per cent, that the normal charcoal irons contained 0.015 to 0.025 per cent.

"We went further, and put oxygen into normal and poor irons by remelting them with a highly oxidized product made only when the furnace had been in trouble and was working too cold to make merchantable iron. By this means we made iron as strong as the best the furnace ever produced. We also tried weakening these strong irons with deoxidizers, and while we could not get out very much oxygen, we reduced it enough to reduce the strength."

The above quotations put briefly the various views held. My interest in the question dates back about 15 years when I had charge of a foundry connected with a firm who owned a blast furnace. This furnace was often on a forge iron burden, and any iron too gray for forge purposes was transferred to the foundry side. Often when the gray forge iron was melted in the cupola, the resultant metal in the ladle showed a curious visible phenomenon. When the ladle of molten metal was skimmed off, and the usual oxide film covered the surface, numerous small bubbles escaped toward the air which immediately spread to the size of a shilling and appeared under these film spots. There appeared to be some chemical reaction taking place accompanied by heat, because these spots were of a higher temperature than the surrounding metal. If the ladle was allowed to stand for a time, as the temperature of the metal dropped, the spots turned black as they came to the surface and spread out. If the oxide film on the top of the metal was now pushed aside, these black patches could be taken from the top of the metal, and would have the appearance and composition of hammer scale.

Metal Lacked Life

It must be borne in mind that during the reaction, if such it was, the top oxide film was not broken, nor did any flame appear as is usual. This phenomenon was of such common occurrence that all the molders recognized it at once. The trouble was that no matter how hot the metal was melted, it lacked life when run into the molds, and short cold shuts on the top side of the castings often showed under the water test.

Taking it for granted that oxide inherent in the iron as received from the blast furnace was the cause, I made small additions of finely powdered 80 per cent ferromanganese down the spout of the cupola as the metal was tapped. This stopped the

Paper presented Sept. 15 at the annual meeting of the Institute of British Foundrymen, held at Blackpool, England.

appearance of the spots at once, and the resultant metal was more fluid. The small additions of ferromanganese had not altered the composition of the metal so far as an analysis showed. It is stated that an increase of oxygen adds to the depth of chill. It should be pointed out, however, that if small amounts of aluminum be added to the ladle there is a decrease of chill. Whether this is due to its deoxidizing effects, or to its action on the carbon, acting to some extent similarly to silicon, is a moot point. I think oxygen does strengthen cast iron, causing the graphitic carbon to be present in a finely divided state, but also agree with Elliot that its lack of life and tendency for blow holes, etc., make it undesirable under cupola conditions. At the same time, it must be remembered that Johnson took his metal direct from the blast furnace, and thereby obtained that amount of superheat in his metal that might overcome these troubles.

That there is a difference between irons of the same composition when made in a cold-blast charcoal furnace and a hot-blast coke furnace, for instance, is now generally conceded.

It should not be taken for granted that the foregoing statement implies an attack on chemical analysis, but it is a warning that with the use of faster driven furnaces, and of fine ore and often poor fuel, there probably is on the market large quantities of pig iron whose physical tests would not be what one would expect from the chemical analysis. Most of us remember the series of tests made by Cook and Hailstone (Proc. 1908 and 1909), in which the lowest results of one set were higher than the best of the other set, although the chemical analysis agreed within practical limits.

Iron Is Little Known

Pilkington (Proc. 1905 and 1906), in speaking of what is known as *over gray* pig, states, "The fracture when cold is a very wild and scattered one, and would in all possibility be graded as a No. 4. The analysis would be equal to a good No. 1. If the usual amount of scrap that a No. 1 carries were melted with its iron in the cupola, the resultant casting would be much harder than usual; in fact, in many classes of work it would give trouble. It has been said that whatever may be wrong with the pig iron in its carbon, that when remelted, that carbon is all restored to its normal condition in the casting. It does not appear possible to controvert such a statement, but the class of iron just referred to is not restored to a normal condition, and I am afraid is little known to metallurgists."

Houghton in a paper the following year confirms the above statement. He also gives the analysis of one of these *over gray* pig irons, which is as follows: Total carbon, 3.53 per cent; graphitic carbon, 2.95 per cent; combined carbon, 0.58 per cent; silicon, 2.94 per cent; sulphur, 0.007 per cent.

No Recovery of Structure

Munnock (Proc. 1908), in reply to a statement that in 99 per cent of cases the composition agrees with the analysis, answers, "I can hardly agree to 99 per cent, but I should say in, perhaps, 50 per cent." Adamson (Proc. 1916), gives us a large number of examples where the fracture bears no relation to the chemical content, one of which supplied to him by Sir R. Hadfield, had the following composition: Total carbon, 3.28; graphitic carbon, 2.22; combined carbon, 1.06; silicon, 0.35; sulphur, 0.026 per cent. Yet the fracture was gray.

Personally, I can substantiate Pilkington's remarks regarding *over gray* pig iron, having used large quantities. There is no recovery of structure on remelting. Perhaps the most curious example of this nonrecovery was one that occurred when our furnace was aiming for a low-silicon iron, with about 1 per cent manganese. One cast of about 25 tons had this remarkable analysis: Graphitic carbon, 3.15 per cent; combined carbon, 0.54 per cent; sulphur, 0.035 per cent; phosphorus, 0.44 per cent; manganese, 0.97 per cent; silicon, 0.18 per cent. Yet with this silicon of 0.18 per cent the iron was perfectly gray.

The analyses were checked at least six times by competent chemists, one of whom melted down a portion in a crucible and cast plates ¾-inch thick which were perfectly gray. The whole 25 tons was remelted and cast into shell containers. These were machined all over inside and out.

The third point relates to the lack of uniformity and lax manner of stating the results of tensile tests. What are engineers to think when some members are boasting that they are obtaining tensile tests up to 47,000 pounds per square inch while many others have difficulty in reaching 22,000 pounds per square inch? In many cases this is due to the great variation in the diameter of the tensile bar as cast, as much as variation in composition.

While at the ministry of munitions I had an opportunity of investigating this question. I found tensile bars in use which varied in the breaking portion from approximately ⅜-inch diameter to 1¼ inches diameter, and from ¼-inch to 1 inch square. Having received reports from another department of bars with abnormal tensile strengths, averaging 45,000 pounds per square inch, being sent in by several firms, I found in each case the small bar was in use.

This difficulty may be met either by having three different sizes of bars to match the composition of light, medium and heavy castings, or have one diameter of bar with specified tests varied with the thickness of the casting the test bar represents. The first has been tried by both America and Germany so far as the transverse test is concerned. While there is distinct theoretical and practical advantages in having the size of the bar to bear some relation to the thickness of the casting it represents, its use was found so cumbersome in work that it was dropped.

At the International Societies for Testing Materials meetings in 1903 a standard bar 1.2-inch in diameter tested on supports 18 inches apart was provisionally adopted for international trading purposes.

The great objections to the American standard specifications are, firstly, that 12-inch centers are too short to register fine correct deflections on a bar 1¼ inches in diameter; secondly, if 21,000 pounds per square inch represents a fair test for castings varying from ¾-inch to 1¾ inches thick, we should expect the test load for 2-inch castings to be less per square inch, instead of the higher figure given in the specification. It stands to reason that if the mixture was made to give the maximum strength at 2 inches thick and over, it would be too hard for a 1¼-inch round bar, and a drop in strength would result.

Transverse and Tensile Test

The last point, and one which will meet with much opposition, is this—I do not think, so far as cast iron is concerned, the tensile test is as good as the transverse test is, as a measure of the *quality* of the iron. The tensile test is more a measure of the structure of the iron, rather than its quality. Put another way, there is no difficulty in conforming to the tensile strength of 20,000 to 22,000 pounds per square inch asked for on a 1.128-inch diameter bar, with any common iron, if the combined carbon is about 0.8 to 1 per cent according to the composition. But it is most difficult to obtain 3100 to 3300 pounds transverse strength on a bar 1 x 2 inches tested 36 inches between supports, made with the same common mixture.

While there is some truth in the statement that the molding and running of these long transverse bars add to the risk of obtaining regular results, this does not meet the whole case. From a log, in which we recorded many thousand tests, covering a number of years, it was curious to note how regular were the results of the tensile tests, and often

how irregular were the transverse tests. It was almost possible to form an opinion of the burden of the blast furnace during certain high and low transverse test results. Perhaps a further illustration will help. If we found the iron from the cupola was not up to the transverse test, it was possible, by adding one pig of a No. 5 high class iron to a 2200 pound charge to raise the transverse test 100 pounds. By adding two pigs to each charge a further 100 pounds on the test would be gained. A third pig to each charge would lift the transverse test up to 300 pounds. The tensile strength would certainly rise a little, but not anything like in proportion to the transverse test recorded.

Research Improves Malleable Castings

UNIFORMITY and dependability has been augmented by the research conducted by the American Malleable Castings association during the past few years, according to a bulletin just issued from the office of Enrique Touceda, Albany, N. Y., consulting engineer for the association. The bulletin covers the results of the tensile tests of bars sent daily from each member plant, and throws interesting light on the results of consistent research work. At the time the research program was inaugurated, with but one or two exceptions, there was no individual uniformity either in manufacturing methods or the resultant product of different malleable foundries.

As rapidly as investigation bore fruit, the findings were disseminated among the member plants in the nature of recommendations for alterations in general plant practices. A great improvement in the physical properties in malleable iron resulted. The most marked advance in development has been made in the past 3½ years during which period the product of association members has increased from an average somewhat under 49,000 pounds per square inch ultimate tensile strength to over 53,000 pounds and from an average under 10 per cent elongation in 2 inches to nearly 16 per cent.

The bulletin covers the report of bars tested by the consulting engineer for the month of June, 1921, when the highest average percentage of elongation of the association as a whole was attained, namely 15.77 per cent in 2 inches, or over twice the elongation required by the American Society for Testing Materials.

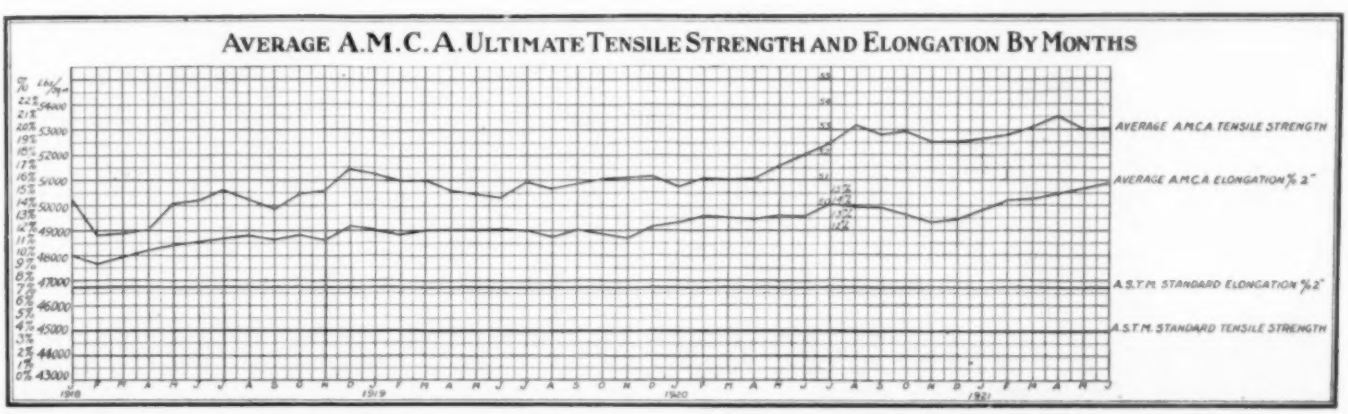
Since elongation is the property on which malleability depends, it will be seen that this report marks a new high level in the research program. Since the first of the year the rise in percentage of elongation has been steady and uninterrupted, and has increased a full 2 per cent. The high water mark for average ultimate tensile strength was reached in April when the figure of 53,530 pounds per square inch was recorded. The June value for this property was 35,038 pounds per square inch. This value is in excess of requirements by slightly over 8000 pounds.

A reference to the accompanying chart showing average ultimate tensile strength and elongation for the product of the membership since January, 1918, indicates clearly how these two properties have increased during this interval. The average of both has always been well in excess of the American Society for Testing Materials' standard requirements of 45,000 pounds per square inch tensile strength and 7½ per cent elongation in two inches.

The constancy of the average values of both tensile strength and elongation maintained throughout 1919 and the spring of 1920, with little apparent improvement over a period of several months, is accounted for by the fact that during that time 22 new plants were added to the list of test bar contributors. None of these had previously profited by the research work, and their submitted test bars in most cases had the effect of lowering the general average. The same effect was felt from August, 1920 to December, when four new contributors were added. No new contributors were added from April, 1920, to August of the same year, nor during the period from December of 1920 to June of this year. The slight retrogression in the average values of both properties from August to November, 1920, is explained by the inability to obtain good pig iron and coal.

Another interesting fact revealed by the bulletin is the high percentage of perfect scores made by the members of the association. By a perfect score is meant the ability of every bar submitted by a member to equal or surpass the standard specifications of 45,000 pounds tensile strength or 7½ per cent elongation in 2 inches. In June of the present year 87 per cent of the contributors made perfect scores.

This general improvement of the product of all members is reflected in the number of certificates that were awarded by the consulting engineer for the quarter ending June 30; 61 plants having been awarded the certificate, the highest number yet issued for any one quarter. The awarding of a certificate is not based upon the test bar alone; the general plant practice as reported by the consulting engineers corps of inspectors being considered in its effect upon the product. Through this safeguard, the purchaser is assured that the test bar record can be considered as a fair representative of the castings.



CURVE SHOWING RESULTS OF MALLEABLE CASTING TESTS SINCE JANUARY, 1918

Crank Cases Made of Malleable Iron

An Extensive Series of Experiments in Molding and in Subsequent Heat Treatment Was Required Before the Castings Were Produced on a Commercial Basis

A NUMBER of years ago a manufacturer of fire trucks whose fire fighting equipment is known in all our large cities, was equipping its trucks with motors mounted on bronze crankcases. Any person who has looked under the hood of a modern fire truck or who has stood on the curb and watched one roaring down the street, or who has seen one throwing a solid column of water for hundreds of feet will bear witness to the fact that these crankcases must be of unusual construction and massive proportion.

On a trip through this factory some years ago E. C. Hagener, president of the United States Malleable Iron Co., Toledo, O., suggested that these engine bases or crankcases could be made in malleable iron instead of bronze at a considerable reduction in cost and without sacrificing any of the features of strength and safety which had prompted the use of bronze originally. Permission to make the trial in malleable was secured with the understanding that if the results were satisfactory an order would be given for several crankcases made of this material.

Patterns were redesigned to a certain extent to meet the peculiar conditions governing casting malleable iron. The patterns were extremely intricate and required the use of many cores to form the molds. Several unsuccessful attempts were made to produce an acceptable casting before a method finally was worked out which resulted in the receipt of the promised order. Since that time malleable iron has taken the place of bronze in all motors made by the fire-engine company.

An idea of the size of these castings may be gained from the accompanying illustrations. The largest, shown in Figs. 1 and 2, a crankcase for a 6-cylinder motor is 5½ feet long and weighs 650 pounds. Fifty-seven cores are employed in the construction of the mold for one of these castings.

One of the molds with the outside cores in place is shown in Fig. 3. By referring to this illustration and also to Figs. 4 and 5, it will be noted that while the mold is made in green sand the greater part of the surface exposed to the metal is formed of dry sand cores. The pattern for the crankcase is made of white metal mounted on a board. The bottom surface conforms to the shape of the casting, but the sides and ends are plain and merely serve as core prints. The cope side is perfectly flat, as may be seen by referring to the illustration, Fig. 3, which shows the cope on the right hand side set up on horses.

Position of Runners

At first these castings were poured from the top, that is, a long runner was cut at each side of the joint from which a number of wide, shallow branches were tapped into the upper flange of the mold. This method while satisfactory as a means of distributing the iron rapidly to all parts of the mold, necessitated an excessive amount of work in the chipping room, besides the attendant risk of breaking the flanges. This method no longer is practiced. Another reason why the long gates on the joint were abandoned, was because they tended to pull the flanges and warp them out of shape.

The present method which readily will be apparent by referring to the illustrations Figs. 3, 4 and 5 has proved eminently satisfactory. Beginning with the cope, Fig. 3, it may be noted that provision is made for pouring the mold with three ladles, one at each end of one side and the third in the center of the other side. The walls of the casting do not average much more than ¼-inch in thickness and it is evident that the mold must be filled rapidly with exceedingly hot iron to prevent cold shuts. Further, the temperature of the metal in the three ladles must be practically uniform, otherwise shrinkage cracks will develop in the casting and render it worthless. Many factors enter into the production of these cast-

FIG. 1—COPE SIDE OF CRANKCASE

FIG. 2—DRAG SIDE OF CASTING

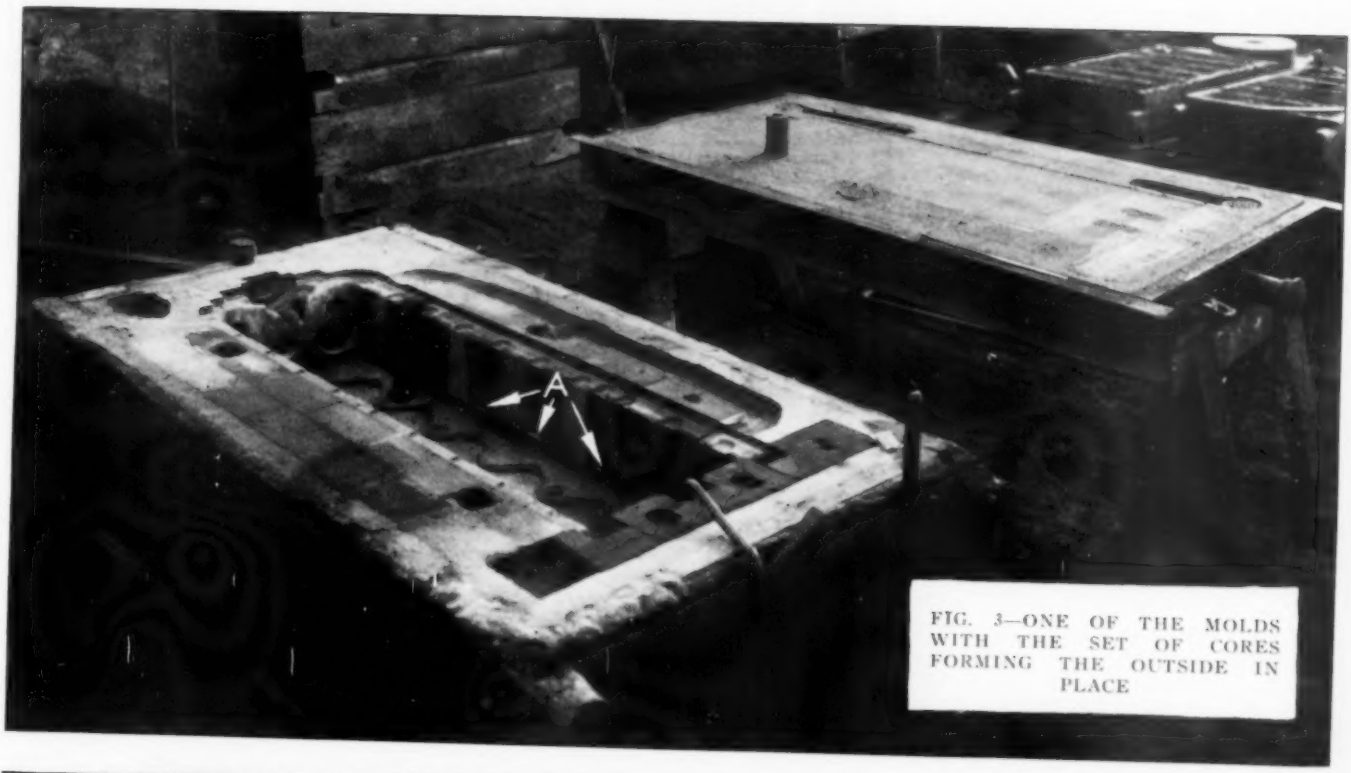


FIG. 3—ONE OF THE MOLDS WITH THE SET OF CORES FORMING THE OUTSIDE IN PLACE

FIG. 4—THE SPHERICAL CAVITIES IN THE GATE CORES SERVE AS DIRT CATCHERS AND ALSO AS FEEDERS

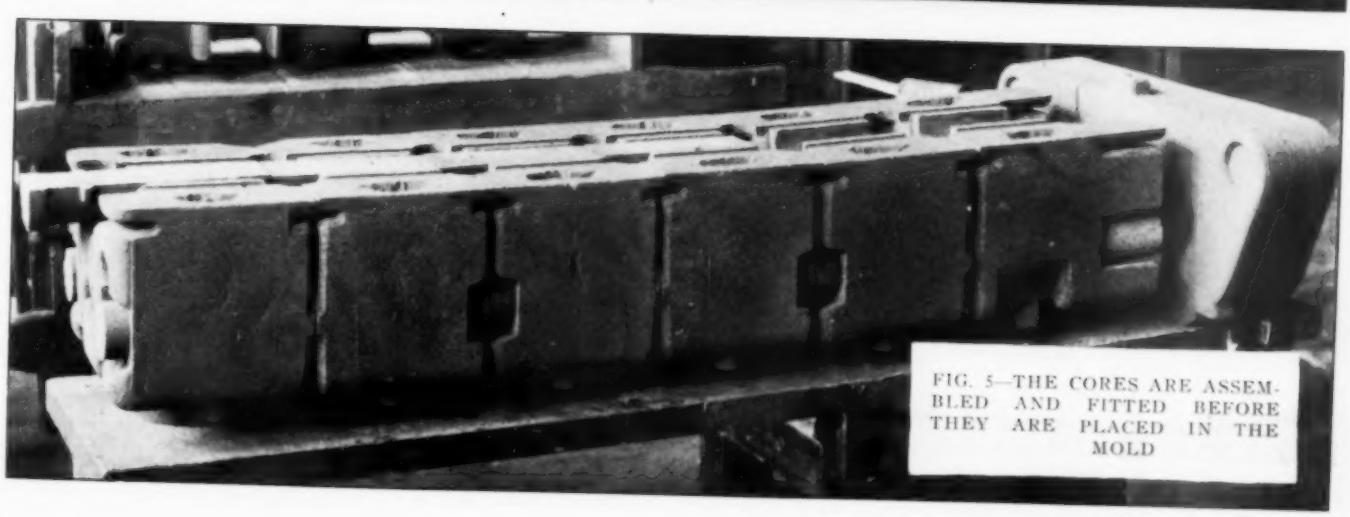


FIG. 5—THE CORES ARE ASSEMBLED AND FITTED BEFORE THEY ARE PLACED IN THE MOLD

ings, but it has been found that accurate control of the temperature from beginning to end, from the time the metal enters the mold until the casting leaves the annealing oven, is the most important.

Setting the Cores

The core that forms the outside of the mold is made in several sections. The sections containing the gates are shown in Fig. 4. This is not a full set, but just a few selected at random to illustrate the details of the gates. The full set comprises six cores, two to form each runner and set of gates. A flat core, not shown, is laid in the bottom of each core print and then the runner cores are set in place. After the cores are set the gates will appear as at *A* in Fig. 3. It will be noted in this illustration that a supplementary gate has been cut in the green sand joint of the mold on the side containing the single runner. While this is not actually necessary in all cases, it is adopted as a precautionary measure in case the metal might be a trifle dull.

After the pattern has been drawn, the cores forming the outside of the casting are set as shown in Fig. 3. Each rests solidly on the bottom and at the back so that no chaplets are necessary. The end core has a tendency to tip forward, but it is held in place by a clamp until the interior cores are set, after which the clamp is removed. A set of interior cores is shown in Fig. 5. A considerable amount of molding sand is used in the core sand mixture to enable the cores to retain their shape while drying. Rosin is used in the smaller cores, but the large cores are bonded with a dry core compound made by the American Gum Products Co., New York. Care is exercised to keep the core sand mixture uniform and to use a minimum of binder so that the cores offer a minimum resistance to the contraction of the casting. The long narrow slits showing on the top of the cores produce the tie rods connecting the various internal transverse ribs in the casting shown in Fig. 2. These bars ¾ x ½-inch help to equalize contraction strains and prevent distortion of the casting both in the mold and in the annealing oven. They are removed in the chipping room after the casting has passed its final inspection.

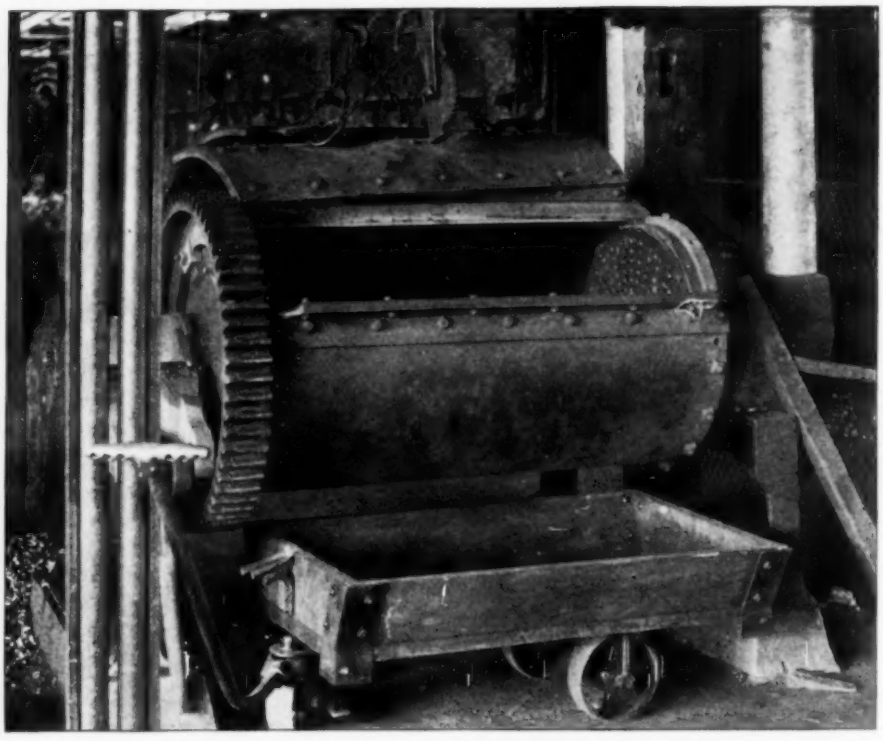


FIG. 7—THE CONTENTS OF THE BOX ARE DUMPED INTO THE TUMBLING BARREL BY A MONORAIL HOIST—AFTER THE CASTINGS HAVE BEEN CLEANED, THE BOX IS PUSHED IN UNDERNEATH AND THE CONTENTS OF THE MILL SPILLED BACK INTO THE BOX

FIG. 6—MASSIVE IRON POSTS TAKE THE PLACE OF THE USUAL TYPE OF I-BEAM BUCK STAYS HELD ACROSS THE TOP WITH TIE RODS

Annealing the Castings

Even with the most extreme care in the molding process, the castings will crack if cooled too quickly. Therefore, they are taken from the mold immediately after they have been poured and placed in an oven previously heated to approximately 800 degrees Fahr. The oven then is allowed to cool. The door of the oven is shown in Fig. 8 also the improvised rig for handling the castings. A length of 60-pound rail suspended from a trolley, operating on an I-beam, is provided at one end with a pair of double hook tongs which engage the flanges of the casting. Holes are drilled through the rail at various points so that it may be suspended at varying distances from the end depending on whether it is required to place the castings far into the oven or deposit them near the door. When the rail is hung near one end there

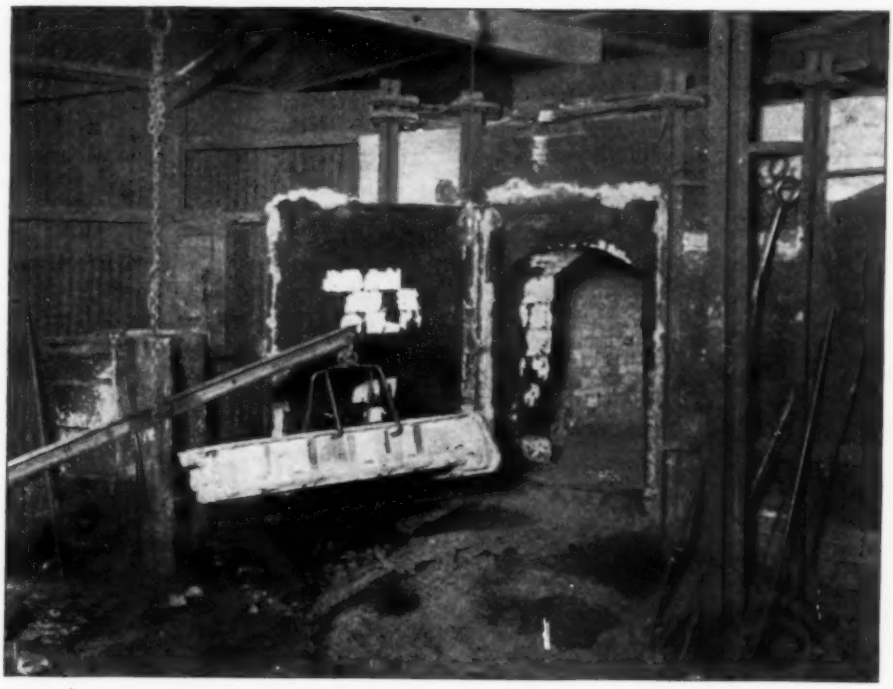


FIG. 8.—A LONG RAIL, SUSPENDED FROM A TROLLEY AND PROVIDED WITH TONGS AT ONE END IS EMPLOYED FOR PLACING THE HOT CASTINGS IN THE COOLING CHAMBER

is sufficient leverage for one man to work the device alone, but when it is hung as shown in the illustration it requires the services of two men. This part of the work must be handled rapidly to prevent an undue radiation of heat from the casting. These castings are placed in a horizontal position in the cooling oven, but later when they are placed in the annealing oven they are packed vertically.

The battery of 15 annealing ovens, situated in a building adjoining the foundry, includes nine with a capacity of 40,000 pounds each and six with a capacity of 30,000 pounds each. They are arranged in groups of five with a separate stack for each group. The ovens are hand fired from the back with soft coal. The handling of fuel is reduced to a minimum by the erection of a long continuous hopper, narrow at the bottom and wide at the top which extends back of the ovens for the entire distance. The hopper is provided with door openings opposite each oven fire door. A locomotive crane operating a grab bucket on the outside fills the hoppers with coal through suitable openings in the roof. A narrow gangway separates the hopper from the back of the ovens and the fireman has only to fill his scoop with coal, turn around and throw it into the fire place in the oven.

Buck Stays Eliminated

The two 15-ton furnaces used for melting iron at this plant are the ordinary type, inasmuch as they are hand fired at the end with soft coal, are provided with removable bungs to permit charging through the roof and frequently are run from 5 to 10 tons above their rated capacity. Each furnace has two tapping spouts—one on each side. One spout is a little higher than the other and it is claimed delivers hotter iron. However, a few features indicating the individuality of the men in charge are worthy of note. Instead of the usual rail or I-beam buck stays held across the top with tie rods, the side walls of these furnaces as shown in Fig. 6 are supported by a number of massive cast iron posts, three of which are shown in the illustration. These posts are anchored firmly in the floor and are provided with brackets near the top end to carry pieces of rails. The rails in turn are held in contact with the upright plates that form a backing for the brick wall.

The horizontal roller mounted on a bracket shown near the left of Fig. 6 is designed to ease the work of the man handling the long heavy skimming rod used for removing the slag. When not in use the roller can be swung to one side out of the way. Another departure from the regular construction of a malleable iron furnace is observed in the method adopted for introducing the top blast above the bridge wall. The usual method is to run a number of small branch pipes from a main pipe extending across over the roof of the furnace. The small pipes are inserted between two of the regular bungs and the space between built up with bricks and mud. However, in this instance a method which it is stated was first developed at the plant of the Benton Harbor Malleable Foundry, Benton Harbor, Mich., is used. One of the bungs, indicated at *E* Fig. 6, is a pipe casting instead of the usual arched brace. The under side is bricked like an ordinary bung and openings are left in the brick work corresponding to the openings in the bottom of the pipe. A spare wind box bung always is kept on hand ready bricked.

Charging the Furnaces

A 5-ton overhead electric traveling crane is employed for charging the furnaces. A long I-beam supported on the rafters extends over the top of each furnace. It is provided with a small trolley to which a chain block may be attached to do any necessary lifting in case any accident might place the crane out of commission. The scrap boxes, shown in Fig 9, are employed for making up the charge. A number of lift trucks similar to the

FIG. 9—THE CHARGE FOR THE FURNACE IS MADE UP IN A NUMBER OF IRON BOXES WHICH ARE TAKEN FROM PLACE TO PLACE BY A JACK-LIFT TRUCK

one shown to the right of Fig. 9, are used to convey the boxes from place to place. A concrete roadway in the yard and concrete gangways throughout the foundry facilitate the work of these trucks. A number of the boxes are placed at different points throughout the shop and are loaded by the men who shake out the castings and gather the scrap, sprues and gates. The remainder of the boxes are placed close to the various piles of material in the stock yard and loaded according to a definite schedule. Theoretically, each box holds a ton of iron, but each one is weighed on scales supplied by the Toledo Scale Co., Toledo, O. The scales are situated just outside the door leading from the stock yard to the furnaces. The man in charge of the charging gang stands by the scales and sees that any necessary adjustments are made before the box is passed. At the furnace, the box is picked up by the crane and when the catch shown at *H*, Fig 9, is released, the box automatically dumps the contents into the furnace.

The ladle carriage, shown in Fig. 10 is another local development. It is provided with ball bearing wheels, is nicely balanced and can be handled with ease by one man. In this connection, and as affording an interesting side light on some of the minor troubles of a foundryman, it is stated that when this carriage first was introduced, the men accustomed to carry iron in the usual double shank with a man at each end, refused to use it. It required tact and patience to overcome their prejudice at a time when labor was at a premium; but now they object even more strenuously if for any reason it becomes necessary to carry a ladle of iron in the old manner.

The floor of the annealing room and also the floor of the cleaning room are paved with wooden blocks. The great bulk of the work consists of small and medium sized castings which are conveyed from place to place in round sheet steel containers mounted on small wheels. The usual sequence of operations is observed, that is the castings first are tumbled in the hard iron mills, then annealed and afterward tumbled in the soft iron mills. Formerly the castings were lifted by hand from the containers and placed in the mills. Recently an overhead trolley system was installed which greatly facilitates the work. A number of wooden boxes have been constructed to be used with the trolley system. These boxes, loaded with castings, are picked up by a chain hoist and the contents dumped into the tumbling barrel. After the castings have been cleaned, the box mounted on a hand truck is pushed in under the mill which then is rolled over and the contents spilled back into the box. The box is then taken to a predetermined point, where it is once more picked up by a hoist on the trolley and the contents dumped on the chipping and sorting bench.

Consideration for the safety, comfort and convenience of the employes is manifested in several items shown in Fig. 7. A high wire screen, part of which is shown at the extreme right of the illustration, extends across both ends and along the entire length at the back of the battery of tumbling barrels. The barrels are connected to a dust exhaust system and each is served by a small ingenious type of hoist, shown at the top center of the illustration, for handling the door. A comprehensive and well arranged lighting system is provided to facilitate the work when it is necessary to work at night or for an hour or two morning and evening during the winter. Heat and ventilation is furnished by a large Sturtevant fan which draws air through wet cloth screens and forces it in winter through a large set of steam coils and then through mains to all parts of the shop. On hot days, the same apparatus with the exception of the steam is utilized to distribute cool air.

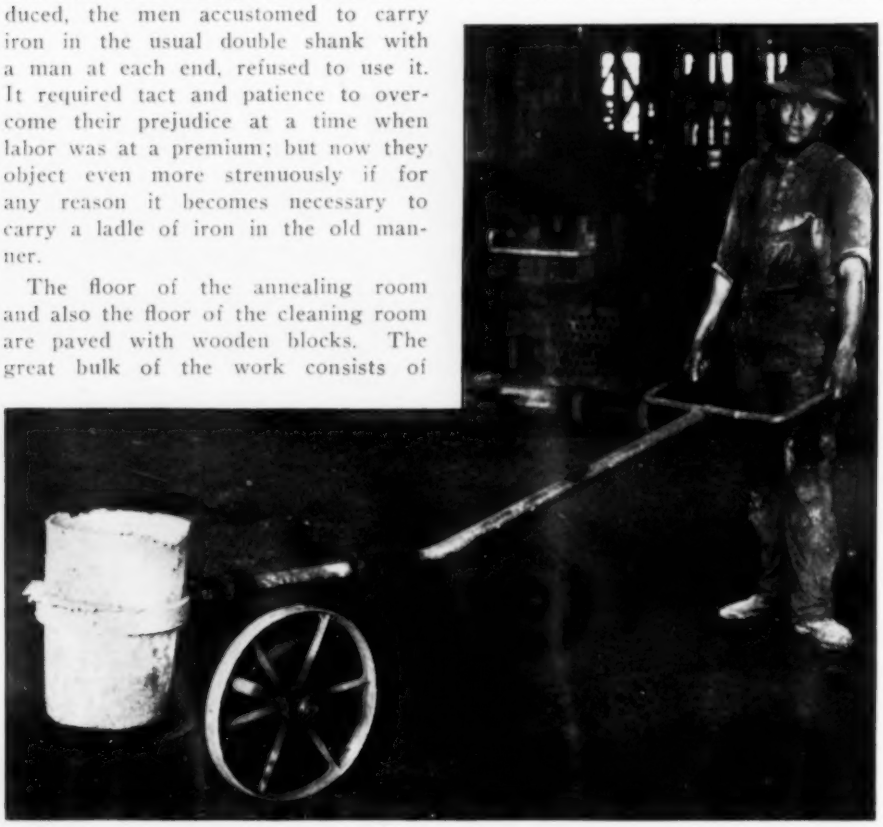


FIG. 10—THE LADLE, MOUNTED ON A NICELY BALANCED FRAME AND RUNNING IN BALL BEARINGS, EASILY IS PUSHED AROUND BY ONE MAN

Reserve Power Plant

Electric current is supplied by the Acme Power Co., Toledo, but the company maintains a complete steam plant which can be utilized at short notice in case the outside power source should be interrupted or suspended. Steam is supplied by a battery of three 200-horsepower boilers made by the Atlas Engine Works, Indianapolis. An air compressor made by the Bury Co., Erie, Pa., is direct steam connected and so is a pump connected to a deep well which is used as an auxiliary to the city water supply. The sand shed, located in the yard at one end of the main building is provided with an arched tunnel projecting above the floor for its entire length and terminating at one end in a smoke stack and at the other end in a fire place. During the winter a small fire maintained in the fire place prevents the sand from freezing.

F. J. Ryan & Co., Wesley Bldg., Philadelphia, industrial furnace builders, recently have established three additional offices. David P. Harr, 423 Depot St., Latrobe, Pa., will have charge of the Detroit agency and also the Cleveland and Toledo districts. The Singer Kennedy Construction Co., 39 W. Adams St., Chicago, will cover the middle west, while L. H. Chamberlain, 72 New Montgomery Ave., San Francisco, has been given the Pacific coast territory.

W. J. Shennan, superintendent of iron, brass and steel foundries, Bethlehem Steel Co., South Bethlehem, Pa., addressed the Philadelphia Foundrymen's association at its regular meeting, Sept. 14. Mr. Shennan's remarks covered a recent trip through the Panama canal into the Pacific to the Hawaiian Islands and return by way of San Francisco.

Grinding Manganese Steel Castings

Frogs and Switches Produced from Accurate Patterns and Carefully Molded—Ground Because Too Hard To Machine—Annealed Before Grinding —Wheels Are Coarse Grit in Hard Grades

BY F. B. JACOBS

MANGANESE cast steel is used extensively in the manufacture of track equipment, as it is hard and tough which impart excellent wearing qualities. At present, however, most of the manganese steel railroad equipment is used by street railways. While it is an acknowledged fact that manganese steel frogs and switches are the most efficient for steam road service, first cost is an item of the utmost importance. This is why manganese trackwork is not being used extensively by steam roads today.

Manganese steel is so hard that it cannot be worked with cutting tools and for this reason makers of manganese equipment are large consumers of grinding wheels. In the plant of the St. Louis Frog & Switch Co., St. Louis, grinding wheels are used extensively. Notwithstanding the great care exercised in making the patterns, preparing the molds, and setting the cores for these steel castings, they must be finished by grinding. The manufacture of this equipment involves grinding of a semi precision nature from the time the castings come to the grinding room until they are ready for inspection and shipment.

After the castings are shaken out in the foundry, they are annealed. Manganese cast steel, unannealed is too hard for track work. In annealing, the castings are raised to a white heat and quenched in cold water. The tank used for this purpose is 10 feet deep and of ample capacity to assure an adequate supply of water at the correct temperature. The next step is to straighten the castings. This is accomplished by heavy hydraulic presses. The operator uses a straight edge to try his work.

FIG. 1—FINISHING A LINE ON A SWITCH MATE WITH A PORTABLE GRINDER

The machine shown in Fig. 2 is a Cleveland open side planer equipped with a grinding attachment for track work. The work in this case is a crossing for a street railway. One end of the crossing is strapped to the platen while the other end is fastened to an outboard support which travels over rollers. The purpose of this support is to take the overhang strain which might pull the platen off its ways.

The piece is first carefully aligned so that the part technically termed the "line," which is the depression in which the wheel flange runs, travels straight under a given point as the platen travels back and forth. Then the top of the rail is ground off true and flat. This grinding is done wet. The wheel used is maxf, 18 inches in diameter, 2½-inch face, 2-inch hole, in 8 grit, M grade run at 1200 revolutions per minute. This results in a peri-

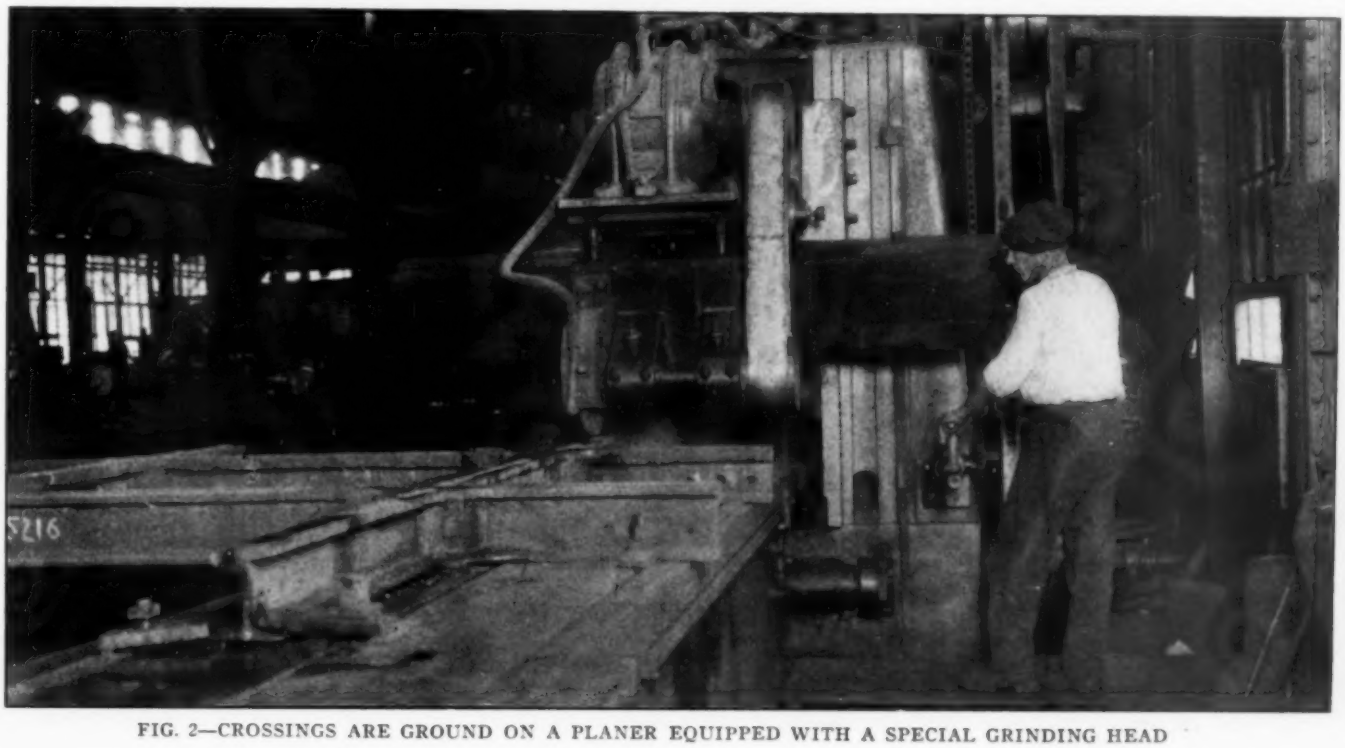


FIG. 2—CROSSINGS ARE GROUND ON A PLANER EQUIPPED WITH A SPECIAL GRINDING HEAD

FIG. 3—CROSSING ASSEMBLED ON THE FLOOR FOR GRINDING

pheral speed of 5654 feet per minute. In this operation the work travels under the wheel at a speed of 26 feet per minute. Approximately ⅛-inch is removed by this operation, the depth of cut for each pass over the work being 1/64-inch.

After the top is ground, the next operation is to grind out the line. The face of the wheel employed is trued to the desired contour and fed down to the work. The wheel used is maxf, 18 inches in diameter, 1¼ inches thick. The grit and grade is the same as that of the wheel employed for surfacing. One-eighth inch is allowed for finishing. With the line ground out, the crossing is reset and another top and line ground and so on until all four rails and lines have been finished. The crossing shown in Fig. 2 is 12 feet long and the grinding time for finishing the rails and lines was 10 hours. Grinding the lines is an exacting operation because where they cross, one cut must not be deeper than the other. This is because in going over the crossing, the flange of the car wheel travels on the bottom on the line so that the wheel tread does not touch the rail. This eliminates the decided jar experienced when a wheel bearing directly on the rail face goes over the gap in the crossing. Gages are using in grinding the lines and in cases where they do not meet exactly at the crossing, that is where one line is a few thousandths of an inch below the other, the difficulty is remedied by grinding out by hand. Other work on this crossing consists of grinding the ends square and removing any irregularities on the surfaces where the fish plates bear. These are hand grinding operations that do not differ from similar operations on other track equipment that will be explained later.

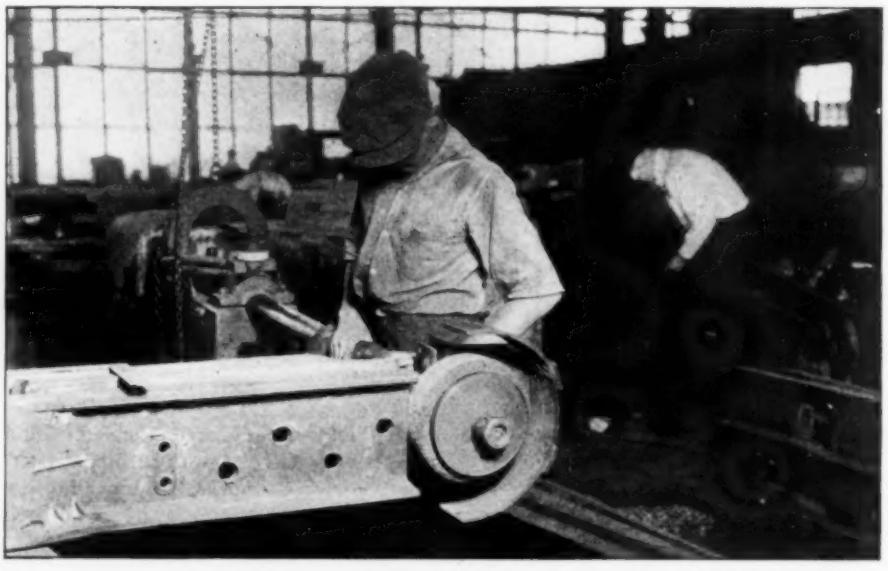


FIG. 5—ENDS OF SWITCHES ARE GROUND TO FORM A SQUARE BEARING

FIG. 4—SWITCH TONGUES ARE GROUND TO FIT THE SWITCH BASE

Another crossing of the angular type, Fig. 3, for steam roads has manganese inserts at the crossing points, the lines being ground with a hand grinder. As the illustration shows, the crossing is assembled on the floor, the various parts being held in place by heavy clamps. Later, the fish plates will be bolted in place as these members hold the crossing together. The machine used for this operation is a U. S. portable electric grinder, equipped with a safety wheel, 10 inches in diameter, 1 inch face having a ⅞-inch hole, in 20-36 combination grit, I grade, operated at 1800 revolutions a minute. This results in a peripheral speed of 4712 feet a minute. As the illustration shows, the grinder is suspended by a chain hoist. By this means the operator is enabled to set it at the proper height. The use of the hoist expedites production as the operator can give his entire at-

FIG. 6—MANGANESE STEEL SWITCH BASE—SEAT FOR THE SWITCH TONGUE IS FINISHED WITH A SPECIAL WHEEL

tention to guiding the wheel as he does not have to support the comparatively heavy grinder. All the hand grinders used in the company's plant are suspended in this manner. The manganese sections ground are 3½ feet long. Approximately ⅛-inch is removed and the grinding time for the four sections is five hours.

The part shown in Fig. 6 is a switch base. In finishing switches, a number of interesting grinding operations are involved. The operation shown in Fig. 5 is comparatively simple as it consists solely of squaring the ends. The grinding is performed with a portable grinder built by the company, equipped with a maxf wheel, 12 inches in diameter, 2½-inch face with a 2-inch hole, in 8 grit, R grade, driven at 1800 revolutions a minute. This gives a peripheral travel of 5653 feet per minute. For this operation, stub wheels are used. The new wheels are 18 inches in diameter and are used in surfacing the tops of rails, as previously described. The surface ground is 6 x 9 inches. Three ends are surfaced on each switch, the production time for one switch being one hour. Approximately ⅛-inch is removed from each end.

The operation shown in Fig. 7 consists of grinding out the floor, heel and circle where the switch point fulcrums. The ground surface is plainly shown in Fig. 6. The machine used is a radial drill equipped with a special grinding wheel head. The wheel used is alundum, 5 inches in diameter, 2½-inch face, in 16 grit, N grade, equipped with a lead center carrying a 1 x 8 left-hand thread. This wheel operates at 1800 revolutions a minute. Grinding is performed both with the periphery and the face of the wheel. As the face of any grinding wheel is comparatively slow cutting when compared with a wheel that cuts on its periphery only, the grinding operation is somewhat slow. In removing approximately ⅛-inch of stock the grinding time is four hours. This is a semi-precision operation as a good fit must be formed for the head of the switch point. Gages are used in determining the correct dimensions. The wheels are economical in operation, however, as they can be used until they are approximately 1 inch thick. Several of these wheel stubs are shown in the right background of Fig. 7. For finishing inside of the double end of the switch base where the fish plates bear, a small wheel on an extension arbor is used. This operation is illustrated in Fig. 8. The machine used is a U. S. portable electric grinder, equipped with a safety wheel, 4 inches in diameter, 1-inch face with a ⅞-inch hole, in 20-36 combination grit, 1¼ grade. This wheel is run at 1800 revolutions a minute which gives a peripheral speed of 2261 feet per minute. In the operation shown, ap-

FIG. 7—GRINDING THE SEAT FOR THE SWITCH TONGUE

proximately 2 square feet of surface are ground, removing 1/16-inch. The grinding time for this operation is one hour. For grinding the open ends where a larger wheel can be used, the grinding time is materially reduced.

The lines on switch mates, that is the path in which the wheel flange runs, are finish-ground by hand, as shown in Fig. 1. The machine used is a U. S. portable electric grinder equipped with a safety wheel, 10 inches in diameter, 1-inch face with a ⅞-inch hole, in 20-36 combination grit, operated at 1800 revolutions a minute. This speed gives a peripheral speed of 5654 feet per minute. The line ground is 12 feet long. Approximately 1/64-inch is ground out. The grinding time for this operation is two hours. The switch mates are previously ground on the machine shown in Fig. 2, where the same wheels are used as previously described in grinding the crossing.

Switch tongues, namely the movable part of switches, require a number of grinding operations before they are fitted in place. The operation shown in Fig. 4 consists of grinding the sides. The machine used is a U. S. portable electric grinder equipped with a safety wheel, 10 inches in diameter, 1 inch face, with a ⅞-inch hole, in 20-36 combination grit, 1¼ grade driven at 1800 revolutions a minute imparting a peripheral speed of 5654 feet per minute. To fit a tongue in a switch takes approximately four hours of grinding. Both sides as well as the top and bottom must be ground. Also, the fulcrum is smoothed so that it makes a free fit in the switch. The tongue shown in Fig. 4 is 6 feet long and approximately ⅛-inch of metal is removed in grinding.

FIG. 8—A SMALL WHEEL IS USED FOR GRINDING IN CONFINED PLACES

The foregoing constitute the principal grinding operations in the manufacture of track equipment. This line of manufacture is one that relies wholly on grinding wheels as the material cannot be worked by other methods. As practically all the operations involved are of a manual nature, it is apparent that the labor cost is an important item. For this reason particular attention is given to the selection of grinding wheels, as poor cutting wheels would prove a losing investment. The St. Louis Frog & Switch Co. also is a large producer of manganese steel castings for other purposes, principally for safes. About 15 tons of manganese steel are poured daily from the furnaces.

German Furnaces Fired with Tar-Oil

BY OBERINGENIEUR KUENSCHER

OIL-FIRED furnaces for melting nonferrous metals are not used as widely in Germany as they are in the United States. Many German foundrymen still cling to the outworn belief that it is impossible to produce as good a quality of metal with the oil-fired furnace as with a coke furnace. This is due partly to the fact that in Germany the foundrymen have been accustomed to the working of the coke furnace since remote times. At many German technical schools, however, courses are now being provided for the purpose of training men so that they shall be thoroughly familiar with the construction and working of oil-fired melting furnaces. The best results are obtained in those works where the owners, managers, foremen and furnacemen are all interested in this method of firing.

Coal-tar oil is freely used in Germany instead of petroleum fuel oil which is too high in price owing to the low rate of exchange. The special advantage of firing nonferrous metal furnaces with coal-tar oil is that with perfect combustion the excess of air is reduced to a minimum. Oxygen and sulphur are the metal founder's worst enemies. With oil firing properly employed the melting loss is unquestionably 2 per cent less than with coke firing. It is of course presumed that a good oil, not containing dirt and water, is used. Ordinary coal-tar oil should not contain more than 1 per cent of water and only 0.2 per cent of other impurities. Coal-tar oil of good quality now costs 110 to 130 marks ($1.16 to $1.39 per 100 kilograms in Germany, while coke costs 40 to 50 marks ($0.57 to $0.62) per 100 kilograms. To obtain a comparative estimate of costs, however, it is not enough to compare the cost of fuels. Account must be taken, in the first place, of the small melting loss, as well as of the other technical and economic advantages derived from oil-firing.

A good mixture of the fuel with the air is essential for perfect combustion. Fig. 1 shows an approved burner on the vortex principle. This vortex is produced by the tangential entry of the air into the mixing chamber. The issuing oil jets are caught by the air and are atomized and mixed by the rotary motion into a fine vapor. This atomization within the burner causes a good burning mixture to issue from the orifice of the burner. Particles of oil, which rush outward under the influence of expansion, are forced against the cone of the flame by the added air which escapes in annular form. The rectilinear velocity of the air is greatly diminished by the vortex, and the ignition point is thus transferred to close in front of the orifice of the nozzle. By this means a fan-shaped flame of moderate power is obtained. The burner is worked by blast air with a pressure of 400 to 600 millimeters water column.

Fig. 2 shows a stationary crucible

Abstract of a paper read before the Association of German Nonferrous Metal Founders. The author, Oberingenieur Kuenscher, is chief engineer of the Duetsche Oelfeuerungs-Werke.

furnace in which the vortex principle is employed. The tangential entry of the burner and the spiral upward movement of the heating gases are clearly shown. Stationary melting furnaces are made for a crucible capacity of 30 to 150 kilograms, and tilting furnaces for a crucible capacity of 100 to 800 kilograms. The duration of melting is, according to the size of the crucible, 20 to 45 minutes for stationary furnaces and 35 to 110 for tilting furnaces. The oil consumption fluctuates between 8 and 12 per cent of the yield, in kilograms.

While with crucible furnaces the heating of the bath is effected indirectly, in melting furnaces without crucibles the operation of the flame is direct. It is only with this method of working that the chemical advantages of oil firing can be fully obtained. Fig. 3 is a diagrammatic representation of the heating of a furnace without crucible utilizing a spiral movement of the heating gases. This method is distinguished by a flame which circles over the metal bath. The burners are so arranged that a "circular vortex" which returns within itself is produced over the metal bath, and this effects a good combustion of the heating gases. A fire ring consisting of heating gases is formed at the outer circumference of the surface of the metal bath, and the movement of these gases is retarded by centrifugal force. This retardation effects a perfect combination of the carbon particles with the oxygen of the combustion air and a neutralization of the flame is produced. The heating gases are set in motion only by the introduction of further quantities of heating gas toward the center of the furnace, and they escape under pressure through the outlet.

For melting nonferrous metals it is desirable that the furnace should be well

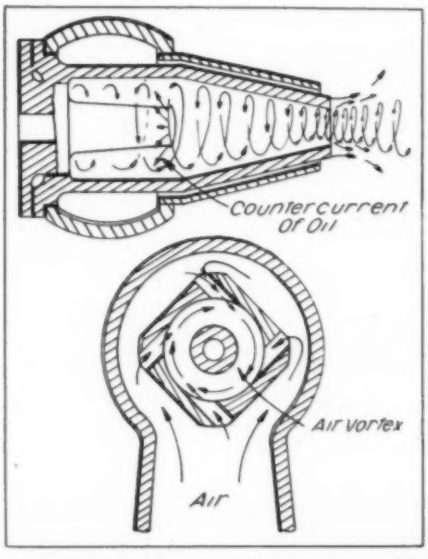


FIG. 1—DETAIL OF TAR-OIL BURNER BUILT ON VORTEX PRINCIPLE

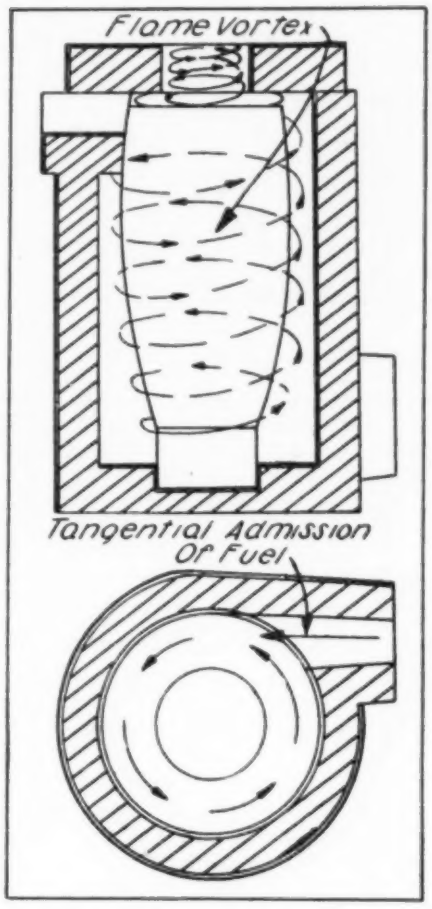


FIG. 2—TAR-OIL FIRED CRUCIBLE FURNACE

heated, so that the melting hearth and the masonry are thoroughly hot. The charge is inserted gradually in order to avoid cooling the furnace too much, and covering materials, such as charcoal, salt, etc., are employed to protect the surface of the metal bath. Furnaces without crucibles are built for a capacity of 150 to 2000 kilograms. The duration of melting is, according to size, 40 to 130 minutes, and the oil consumption 5 to 8 per cent of the weight of metal melted, according to the nature of the alloy.

Shows Heavy Decline In Foundry Employment

Employment in foundries and machine shops, including establishments making foundry and machine shop products, dropped 45.8 per cent during the full year from June, 1920, to June, 1921 ,according to a survey made by the National Industrial Conference board, New York, just made public.

The report sets forth that the figures are based upon statistics covering 625 establishments, the same being obtained entirely independent of government or other surveys, and are the result of the boards own investigations. It also is pointed out that the report does not include shops or establishments producing automobiles, agricultural implements and vehicles or electrical apparatus and machinery.

Study of 25 representative plants in the foundry and machine shop industry showed the following results: Decline in male common labor, 47 per cent; decline in all other male labor, 31 per cent; decline in all classes of women employed, 64 per cent; average decline, 36 per cent. Skilled labor therefore suffered the least.

An interesting feature of the survey is that hourly earnings of those employed in these 25 shops declined but 6 per cent while the decline in weekly earnings was 17 per cent.

Hoosier Foundry Ends Century of Service

Just 100 years ago Seward & Co., Bloomington, Ind., was organized to make iron castings, and the same firm has been continuously in business there ever since. It is probably the oldest business in the state which has continued under the same firm name and by direct descendants of the same family for 100 years. The business was started by Austin Seward, who settled in Bloomington, Sept. 14, 1821, and immediately set up a log cabin shop near the public square. A brick building, a part of which still is standing, soon afterward was erected on the same site. The concern has passed through the hands for four generations and is now conducted by Fred and Austin Seward, graduates of Indiana university.

The Metals Coating Co. of America recently removed to a new plant at 495 North Third street, Philadelphia. This company formerly was located in Woonsocket, R. I., and Boston, Mass.

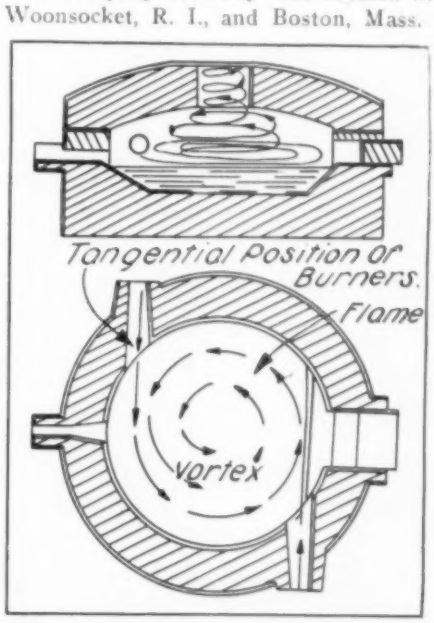


FIG. 3—TAR-OIL FIRED FURNACE FOR MELTING NONFERROUS METALS WITHOUT CRUCIBLES

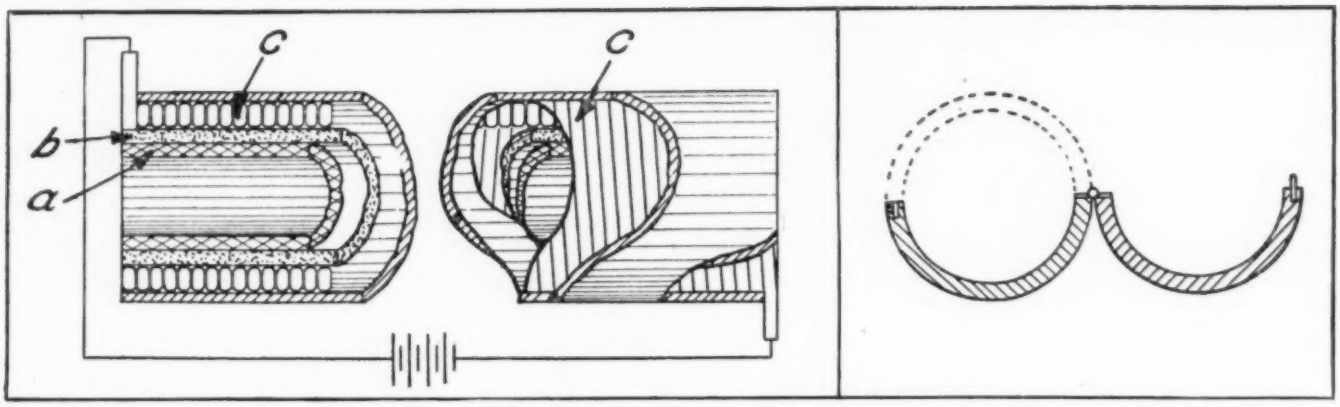


Fig. 1—Induction-type Mold for Centrifugal Casting of Steel Tubing. The Metal is Melted in the Mold Which is Then Placed in a Sheath (Fig. 2 at Right), and With it, Into the Spinning Bench

Melts Metal For Pipe in the Mold

Centrifugal Casting Process Developed by New York Inventor Uses an Electrically Heated Mold—Aluminum Tubing Made by This Process Which Will be Developed for Casting Steel

BY E. C. KREUTZBERG

DEVELOPMENTS of a revolutionary character in the centrifugal casting of pipe have resulted from investigations carried on by Leon Cammen, Cammen Laboratories, 42 West Thirty-ninth street, New York, and which are covered by basic patents just issued to him. By Mr. Cammen's process, the metal is melted electrically in the same mold in which it is cast. In other words, the mold is an electric furnace as well as a mold. Castings have been produced successfully by the new method at the Cammen Laboratories and the process has been demonstrated commercially. In discussing the field for pipe produced centrifugally by his method, Mr. Cammen has set forth his expectations of the large extent to which his process will be employed for producing steel pipe.

"It is impossible at this time to foreshadow the entire field for centrifugally cast pipe," said Mr. Cammer, "but it is wide. Pure aluminum, for instance, does not cast well. Recently we produced some aluminum tubing by the centrifugal method. The resulting product was of exceptional quality. It had no imperfections inside or out. By the centrifugal process, tubing will be produced commercially from a host of metals and alloys never before regarded as applicable to production of this product."

In commenting on the status of the art, Mr. Cammen stated that the process of casting centrifugally is old, having been employed extensively for producing articles of wax, chocolate, lead, etc., but that its application to metals having a high melting point is a development of practically the past eight years. Tests of the cast iron pipe produced by the de Lavaud centrifugal process, of the centrifugally cast piston rings and engine cylinder linings produced by the Stokes Castings, Ltd., Mansfield, England, of the centrifugally cast copper bands produced by the George C. Clark Metal Products Co., Detroit, and of the centrifugally cast tubes made by W. H. Millspaugh, Sandusky, O., says Mr. Cammen, prove conclusively that the centrifugal method of casting is capable of producing tubing of high excellence. The methods heretofore employed, however, Mr. Cammen holds, are not suitable to quantity production, and do not admit of a full realization of the potentialities of the centrifugal casting principle as it has been developed.

"The particular feature that makes the Cammen process of centrifugal tube casting commercial," said Mr. Cammen, "is that, instead of melting the metal outside and pouring it into the mold, the metal is melted electrically in the mold and then subjected to the spinning process. In other words, in this process, each mold is a little electric furnace in which the metal first is melted and then spun into a tube. Where the metal is melted in an outside furnace, the main difficulty in making tubular goods lies in the tendency of the metal to chill, especially when it strikes the comparatively cool mold. In order to obviate this difficulty the mold must be preheated. This is accomplished electrically in the Cammen process in the same way as the melting of the metal is accomplished. The equipment employed in this process is designed not only to afford thorough control of the temperatures, but also of the composition of the metal. In fact, the entire process has been worked out to operate automatically."

The type of furnace on which the centrifugal casting mold is patterned in the Cammen process varies the condition in each case. For small steel tubing, up to and including 6 inches in diameter, the induction type, in particular high-frequency, has been found preferable.

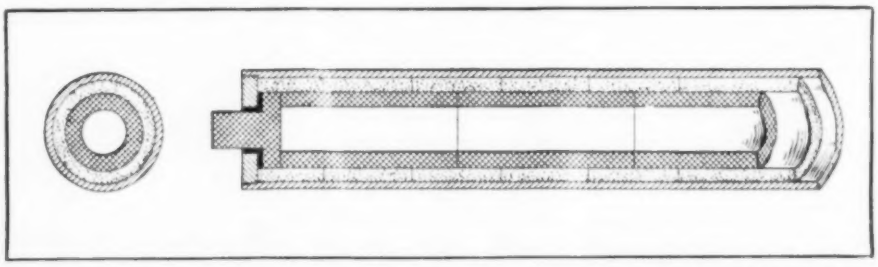


FIG. 3—RESISTANCE TYPE MOLD. THE INNERMOST LAYER IS A CONDUCTOR AND NEXT TO IT IS A REFRACTORY LINING, AND ON THE OUTSIDE A METAL TUBE

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

COMMERCIAL GRADES OF ZINC, OR SPELTER

One of the large producers of zinc carries the following brands, which are grades in the order of their purity as follows:

Horse Head
Bertha
Sterling
Franklin
White Bronze
Nassau

Horse Head Spelter

The brand known as Horse Head is spelter of the highest quality. It will average more than 99.94 per cent pure. It is produced from ores taken from the mine at Franklin, N. J., and is free from cadmium, an impurity supposed to be harmful for making what are known as *slush* castings of zinc. Slush castings are made in metal molds by filling the mold, allowing a time interval to form a crust next the metal surfaces, then pouring out the liquid center. Cracked castings in this process are the result of impurities in the spelter.

The following are the maximum limits allowed for impurities in this brand of spelter:

	Per cent
Lead	0.05
Iron	0.011
Cadmium	none

Horse Head spelter is shipped in slabs 18¾ inches long, 8¾ inches wide, and 1¼ inches thick, the average weight being 47 pounds.

Bertha Spelter

Bertha spelter is similar to the Horse Head brand. It is manufactured under the name of Bertha to suit the wishes of certain customers of the producer. The limit of impurities is the same as that for Horse Head spelter, therefore, it makes no difference which of the two brands are used for any particular purpose, both being equally pure. It is shipped in the same size slabs as Horse Head, merely the stamp being different.

Sterling Spelter

Sterling spelter is not quite as pure as either Horse Head or Bertha spelter, but is sufficiently so to conform to the requirements of the United States army ordnance department, for Grade *A* spelter. A minimum of 99.50 per cent zinc is specified and the impurities are limited as follows:

	Maximum Per cent
Lead	0.10
Iron	0.03
Cadmium	0.50
Aluminum	none

It is shipped in slabs, the size and weight of which are the same as for Horse Head and Bertha brands.

Franklin Spelter

Franklin spelter is made from the Franklin ores; it differs from Sterling in that it contains no cadmium, but higher lead. The impurities of this brand are kept to the following limits:

	Per cent
Lead	0.3 to 0.5
Iron	0.0 to 0.015

The slabs weigh the same as in the case of the previously mentioned brands.

(*Concluded on data sheet No.* 400)

COMMERCIAL GRADES OF ZINC, OR SPELTER

White Bronze Spelter

White Bronze spelter is made to meet the demands of industries requiring a grade of zinc that will have a restricted and uniform lead content. Impurities are limited as follows:

	Per cent
Lead	0.12 to 0.20
Iron	0.00 to 0.015

The sum of the impurities, lead, iron and cadmium range from 0.12 to 0.25 per cent. White bronze, therefore, is a high grade spelter from the viewpoint of the brass foundryman.

Nassau Spelter

Nassau spelter is made in three grades to conform to the requirements of various manufacturers. These grades are as follows:

Brass Special (3) Grade, Nassau Spelter

Brass Special conforms to the requirements of the United States army signal corps (specifiction No. 11,012) for Brass Special, or 3 spelter. The requirements for zinc are a minimum of 99.00 per cent, and the impurities are limited as follows:

	Maximum Per cent
Lead	0.60
Iron	0.03
Cadmium	0.50
Aluminum	none

The amount of lead, plus iron, plus cadmium, is limited to a maximum of 1 per cent.

Brass Special (3) grade comes in slabs 18¾ inches long; 8¾ inches wide, and 1¾ inches thick. The average weight is 57 pounds.

Selected (4) Grade, Nassau Spelter

Selected grade spelter meets the requirements of the United States army signal corps (Specification No. 11,012) for Selected or *D* spelter; also the requirements of the American Society for Testing Materials, specification for Selected or 4 spelter. A minimum of 98.75 per cent zinc is allowed and the impurities are limited as follows:

	Maximum Per cent
Lead	0.80
Iron	0.04
Cadmium	0.75
Aluminum	none

The amount of the lead, plus the iron plus the cadmium is required to be not more than 1.25 per cent.

Selected grade is shipped in slabs, 18¾ inches long, 8¾ inches wide, and 1¾ inches thick, weighing 57 pounds.

Prime Western (5) Grade Nassau Spelter

Prime Western spelter meets the requirements of the United States army signal corps (Specification No. 11,012) for Prime Western or *E* spelter; also the American Society for Testing Materials Specification for Prime Western or 5 spelter.

The specifications for this grade of spelter require a minimum of 98.32 per cent zinc and the impurities are specified within the following limits:

	Maximum Per cent
Lead	1.60
Iron	0.08

Prime Western spelter is shipped in slabs 18¾ inches long; 8¾ inches wide, and 1¾ inches thick, which weigh 57 pounds each.

(*Concluded from data sheet No.* 399)

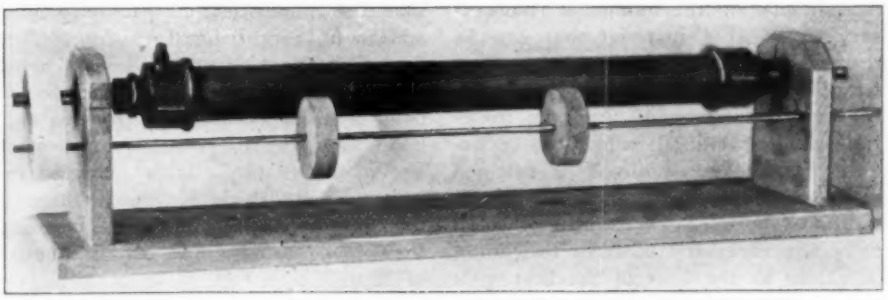


FIG. 4—EXPERIMENTAL SPINNING BENCH. THE TUBE IS ROTATED BY FRICTION FROM THE ROLLERS

For larger sizes, it appears better to melt the metal and heat the mold by passing a resistance current through it and the lining. The selection of the type is a matter of judgment in each particular case. A mold of the induction type is illustrated in Fig. 1. It consists essentially of a refractory tube, *B*, surrounded by a copper tube spiral, *C*, through which is sent a high-frequency current of approximately 6000 volts at 11,000 cycles. A constant stream of cold water is sent through the tube in order that the exterior of the mold may be kept cool. When it is necessary to protect the refractory from the action of hot metal, an auxiliary lining, *A*, is added. In order to enable the mold to withstand the stresses due to spinning, and to protect the copper tubing from possible injury in the spinning bench, the entire mold is enclosed in a sheath, illustrated in cross-section in Fig. 2. The design of the molds embodying the resistance principle is illustrated in Fig. 3.

Metal is charged into the mold in the form of a cold bar of the desired analysis and weight. It is contemplated that when the process is adapted to a tonnage production basis, hot bars will be charged immediately after they have been cast from open-hearth, crucible or electric furnaces, thus retaining their original heat. Where a cold bar is charged, the mold is placed on a rack and the electric current applied until the metal has been thoroughly liquified. During this stage the mold is turned continuously in order that the metal, as it softens, may not have a prolonged contact with any portion of the lining as this would result in damage to the mold.

Requirements of Spinning Bench

From the rack the mold is transferred to the spinning bench. The latter is of substantial construction and must be erected on a solid foundation, since a great amount of vibration would prevent the production of perfect tubes. The bench is of heavy steel "A"-frames spaced 2 to 3 feet from each other. Through these extend three lengths of steel shafting, 2 to 3 inches in diameter. The mold is placed in the spinning bench by lifting the top shaft, and the mold is spun by contact with friction wheels mounted on the shafts on 8-inch centers. The shafts may be adjusted by means of set screws located in the "A"-frames. Great care is observed in keeping the

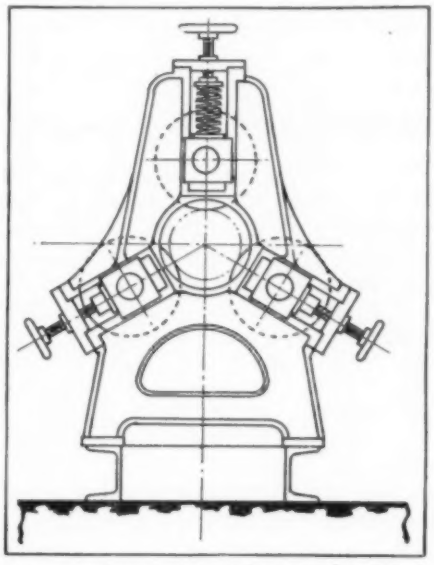


FIG. 5—SPINNING BENCH, FRONT VIEW, SHOWING THE A-FRAMES THAT CARRY THE TUBE MOLD AND SHAFTS WITH THEIR FRICTION ROLLERS

shafts perfectly aligned, since, if the axis of the mold does not coincide exactly with the axis of rotation, the castings will be thicker on one side than on the other.

The speed of spinning varies for each metal and each size of tubing and must be determined carefully. Excessive speed in spinning alloys of metals having widely different specific weights, may lead to segregation. In the case of bronzes, for instance, it would result in a higher tin content near the center than at the periphery. The length of spinning time also is dependent on the kind of metal and the size of the tubing.

The time of spinning has an important bearing on the lay-out of the process. For instance, if it requires a total of four minutes to transfer a mold from the rack to the spinning bench, to spin it and to withdraw it in order to make room for another mold, the rack must have capacity for supplying 15 molds an hour. If it requires one hour to bring the cold metal to a liquid state, therefore, the rack must have capacity for 15 molds.

The principal investment in producing tubing by the centrifugal method, Mr. Cammen says, is in connection with the equipment for generating electric current for melting the metal. It is figured that to melt one pound of steel, about 1 kilowatt per hour is required, starting with cold metal. For a 10-foot tube, with an internal diameter of 2½ inches and an outside diameter of 3 inches, weighing about 7 pounds per foot, generating equipment of 70 kilowatts is required. The size of the total electric generating equipment, therefore, is determined by the amount of current that will be consumed at one time, and this factor is directly related to the capacity of heating rack, and, in turn, to the capacity of the spinning bench. Incidentally, Mr. Cammen figures that the total cost of producing steel tubing by his process now is 6½ cents per pound at the most, not including selling expenses.

Must Machine Linings

The selection of materials for the linings of the mold is a matter of great importance. Where the resistance principle of heating is employed, it is necessary to use a conducting material, like graphite, for the lining. Electric current is applied to the conducting lining which thus may be brought to any desired temperature. Where the metal attacks the lining, as when graphite

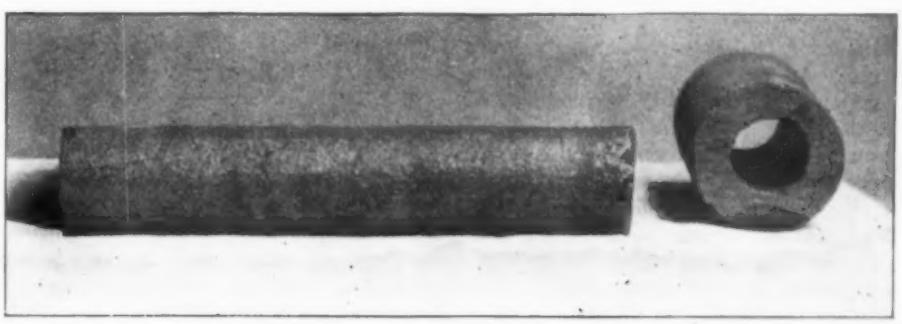


FIG. 6—CENTRIFUGALLY CAST ALUMINUM TUBES

is used in casting steel tubing, an auxiliary lining is provided for protective purposes. For instance, a zirconium oxide wash may be used over a graphite base. A careful investigation has shown that when the induction principle is employed, a properly prepared lining made of zirconium oxide, with or without binders, stands up under repeated meltings and gives a smooth surface not subject to excessive spalling. The inner and outer circumference of each section of the lining must be strictly concentric as otherwise the castings will not be of uniform cross-section. Such a strict concentricity cannot be secured in the kiln. Therefore, in making the linings, it is necessary to select a material that can be reamed or ground to exact dimensions. Graphite can be machined and zirconium oxide ground. Another material which is suitable when the induction principle is employed, is calcined magnesia with which a binder, such as tar, must be used. With this material it is not necessary to bake the lining in a kiln as the heat of the first melt supplies all the baking necessary.

Cleaning Interior of Tubes

A device has been developed for cleaning off the inner surface of the tubes, since it is on the inner surface that the impurities and imperfections appear in a centrifugal casting. This device, in effect, is a lathe with a great distance between centers. The tube is held in what corresponds to the tool holder and the tool itself is somewhat like a shaper tool. It is mounted on a large bar which is drawn through the tube at high speed, thus cleaning the inner surface in a small amount of time.

Mr. Cammen has optioned the plant of the Metal Alloys Co., Elizabeth, N. J., and, with his associates, will employ his process there for manufacturing aluminum bronze tubes of all diameters in the near future.

How and Why in Brass Founding

By Charles Vickers

Bad Metal Expensive

We have experienced considerable difficulty lately in our brass foundry. We make steam and water specialties, melt in an oil-fired, tilting, noncrucible furnace and pour with a No. 40, crucible used as a ladle, and heated before being used. A large number of castings are cold shut. Many castings leak, especially after we have added a little aluminum to deaden the fumes. Some castings are spongy. Some contain blowholes, and when the metal contains over 5 per cent lead, the lead sweats out. Also some of our cores are too soft and others too hard. The metal we use consists of brass ingot. We send samples for your inspection.

Two of the sample castings appear to be of different metal from the others. They are bright and clean and others are dirty and drossy. If they are the results of separate heats, but from the same consignment of ingot metal, this indicates the ingot is not of uniform composition. If they had been made from new metal, it would be possible to get these results from the same heat; then it would show the metal was not mixed by stirring or other means of agitation. The dirty looking castings are that way because the metal contains too much zinc. It has been cheapened to the limit. It does not pay to use such metal, the loss of production due to bad castings many times offsets the advantage of the cheap metal. One of the castings is shifted. This may be due to a shift between cope and drag, or to improperly ramming the cope. Anyway the casting would have been bad because of the poor metal. The metal will run if 2 ounces aluminum per 100 pounds of metal is added as a maximum, but the castings will leak. Aluminum cannot be used for pressure goods made of yellow brass. A yellow brass for such work should never contain over 5 per cent of lead. The remedy is to use a higher grade ingot metal. The limit of zinc should be placed at 30 per cent. When higher zinc than this is used, it will have to be burnt out to get good castings. Otherwise, the difficulties enumerated in the query will be encountered. The blow holes are due to improperly vented cores or to cores that are too hard.

A mixture as follows will give better results:

SOFT YELLOW BRASS

	Pounds
Copper	70
Zinc	27
Lead	3

A better grade of yellow brass suitable for hose couplings is the following:

YELLOW BRASS FOR HOSE COUPLINGS

	Pounds
Copper	65
Zinc	30
Lead	3
Tin	2

Mixture for Bearings

We are desirous of getting a suitable mixture for bronze bearings about 14 inches in diameter. These bearings are used on a machine under severe service conditions. We have tried an alloy of copper, 80 per cent; tin, 10 per cent, and lead, 10 per cent but it does not stand up.

The following formula will be found suitable for the purpose stated:

	Pounds
Copper	86.50
Tin	11.00
Zinc	2.00
30% Manganese copper	.50

Melt the copper under charcoal, when clear and limpid add the manganese copper, stir, follow with the tin.

Recommends Changes in Valve Patterns

We have experienced great trouble with brass cock bodies designed to stand a water pressure of 600 pounds per square inch. We have tried every method we can think of to overcome the difficulty and we still get approximately 25 to 75 per cent rejects. We have gated them in all possible ways, every man in our foundry has worked on them, and we have placed them in every position in the mold. We also have used all grades of brass, especially ingot, which has been guaranteed to stand 600 pounds pressure. The result is still the same.

We use chiefly scrap brass to which we recently have added 16 ounces to a 50-pound crucible, of a hardener composed of tin, phosphor-tin, lead and zinc. This gave slightly better results, but it makes the castings brittle.

What we want is a mixture as an addition to our scrap that will suit varied requirements as to malleability, and at the same time stand 600 pounds pressure per inch. We particularly want to use scrap. Can you help us?

If brass scrap the world over was of

one standard composition we would be in a much better position to offer helpful suggestions than at present when the scrap will vary exceedingly in composition, and there are many kinds of scrap, and particularly war scrap that is entirely unfitted for casting pressure goods. As different grades of brass have been used and every possible method of molding and gating them has been tried without success, it would appear the fault of the rejections is not in the metal but is in the design of the valves. In this connection we make the suggestion the patterns be carefully overhauled, as the walls of the valves are likely too thin to withstand this pressure. A slight thickness added to the metal might correct the difficulty and give such good results from a production standpoint that the extra weight of metal would be compensated many times. The valves then could be run with the regular work without difficulty.

Evidently there is something wrong with the patterns, and this defect necessitates the use of high grade alloys in order to minimize the loss from leakage. The following alloy if carefully melted under charcoal can be relied upon to hold the pressures.

PRESSURE RESISTING ALLOY

	Per cent
Copper	89
Tin	6½
Zinc	2
Lead	1½
Nickel	1

Run a trial heat of this alloy and test the valves. If a large portion of these are leakers, it is a waste of time to continue with the patterns as at present made.

Solders and Fluxes for Use With Aluminum

We would like to obtain a little information about aluminum solders and fluxes.

An aluminum solder used extensively is known as Richards aluminum solder. It has the following composition:

	Per Cent
Tin	63.00
Zinc	31.00
Aluminum	3.00
Phosphor tin	3.00

Another solder suggested by the bureau of standards has the following formula:

	Per Cent
Tin	81.00
Zinc	9.00
Aluminum	5.00
Phosphor tin	5.00

A flux sometimes used for soldering aluminum has the following composition:

	Ounces
Tallow	40
Resin	40
Zinc chloride	10
Water	10

Melt the tallow and resin together, remove from the heat when they are set, but soft, stir in the water and the zinc chloride.

Causes of Porous Spots

We are making castings which when polished must be flawless, but are having difficulty in getting them perfect. After they are polished clusters of small holes will be exposed on the top surface of the casting, the latter being shaped like a small dome with flat top. The alloy is copper 83 per cent; tin, 3 per cent; zinc, 12 per cent, and lead, 2 per cent. Just before stirring the metal, a piece of phosphorus-copper the size of two navy beans is added. The same type of pits sometimes are found on the bodies of faucets.

The casting is shaped like a pill box cover with deep sides and rounded corners. The flaws show as small porous holes on top, but are not uniformly distributed, being clustered in one small area, in the case of the sample submitted.

The difficulty is not caused by porosity inherent in the metal due to inattention while melting. It is largely caused by the green sand core which is not sufficiently permeable to the gases developed by the hot metal. Use a facing on the drag, composed of sand with a large percentage of new sand. Ram the drag thoroughly around the sides of the castings, but lightly over the cores. Never allow hot sand to be filled in when ramming the drag. We would be inclined to omit the phosphor-copper addition in the case of this alloy; it should not be necessary. In one spot a grain of sand has cut entirely through the casting. It will be necessary to have clean molds. Sharp sand must not be used as parting. The gates and sprue must be perfectly clean. A well burned molding sand will cause the defects shown by this sample casting, as the sand grains have been disintegrated by the heat to a dust which fills up the pores in the mold, and holds back the gases.

Brass Mixture for Use in Spark-Gap Spheres

We wish to cast 4 hemispheres 20 inches in diameter with the shell ⅜-inch thick. These hemispheres will be made into perfect spheres, and used for a spark gap in measuring high tension voltage. It is desired to find an alloy, such as brass, that will give a perfect casting without the slightest suggestion of pinholes, which can be machined readily and is sufficiently hard to take a polish and not easily scratch. In order to obtain nonarcing qualities it is desirable to have an alloy containing at least as much as 50 per cent zinc. Electrical conductivity is no object. Your suggestions will be valued.

An alloy of copper 50 per cent; zinc 50 per cent can be cast provided a little aluminum is added. However, the metal will be weak and easily broken as the zinc is too high for the copper content. To the alloy of 50 copper, 50 zinc, add about 2 ounces of aluminum per 100 pounds. This will make the alloy run easily into the molds. It is possible that it will be too hard to machine well, also that the fracture will be mixed golden and greenish, and the metal weak. The addition of 0.25 per cent magnesium will correct the mixed fracture, and will produce a steel-like fracture; but the alloy will still be rather brittle. Fifty per cent of zinc is too high for a copper alloy, that is an alloy in which the copper content approximates that of the zinc.

A better alloy would be the following:

STRONG NONARCING ALLOY

	Pounds
Copper	55.50
Zinc	43.00
Iron	1.00
Aluminum	0.50

Add the iron in the form of tinplate to the molten copper, then add the aluminum, lastly the zinc.

Formula for Monel Metal

We will appreciate your sending us the formula for monel metal.

Monel metal is not made to a formula. It is a natural alloy originally obtained from the Sudbury district of Canada. Monel metal can be obtained from the makers in shape for remelting to make castings; or monel metal scrap can be purchased in the open market. The navy specifications for monel metal follow:

MONEL METAL SPECIFICATIONS

	Per Cent
Copper	36.00
Nickel	60.00
Iron	3.50
Aluminum	0.50

An analysis of monel metal showed the following:

MONEL METAL ANALYSIS

	Per Cent
Copper	26.70
Nickel	68.00
Iron	2.56
Manganese	2.55

Other analyses have shown the presence of silicon and lead, a combination better left out of any metal. The alloy can be made by following either of the formulas given.

Loam Molding Presents Difficulties

An Application of Common Sense Methods Based on Practical Experience Rather Than Scientific Knowledge Solved an Apparently Hopeless and Unsatisfactory Situation

BY GEORGE BOYS

IN the concluding paragraph of a recent editorial appearing in THE FOUNDRY it was stated that while an accurate and scientific knowledge of sand, at least in its application to the foundry, is desirable and eventually will be as common among foundrymen as analysis of iron has come to be, in the meantime, an application of common sense will help to eliminate a great deal of the loss due to unsuitable sand or to sand that has been improperly prepared on the foundry floor.

This statement coincides with an experience I had upon assuming charge of the foundry of the United States & Cuban Allied Works Engineering Corp., Havana, Cuba, a few years ago. The works superintendent conducted me around the plant and pointed out many things which were causing trouble. He was not a practical foundryman and since he was forced to rely on his men for information on the subject of defective castings and since these alleged reasons emenating from different men frequently were of a contradictory character he frankly admitted that he did not know what to believe. Of course, he had theories of his own, but lacking foundry experience he hesitated to put them into practice.

He felt that the cause of most of their troubles could be traced to the molding sand employed, but none of the men heretofore engaged had seemed to appreciate that factor; or if they had recognized it they had failed to take any steps to change or improve its condition. It was almost impossible to dry a large core properly owing to the clayey character of the red sand. This sand to the touch seemed to be impregnated with an oily substance and was so heavy that it felt like clay mixed with lead.

We stood and watched the chippers cleaning the core out of a 40-inch elbow and I noticed that the core was burned like a rock, entailing an enormous amount of extra labor, and the same held true for a roll casting in which the sand was fused to the skin of the casting.

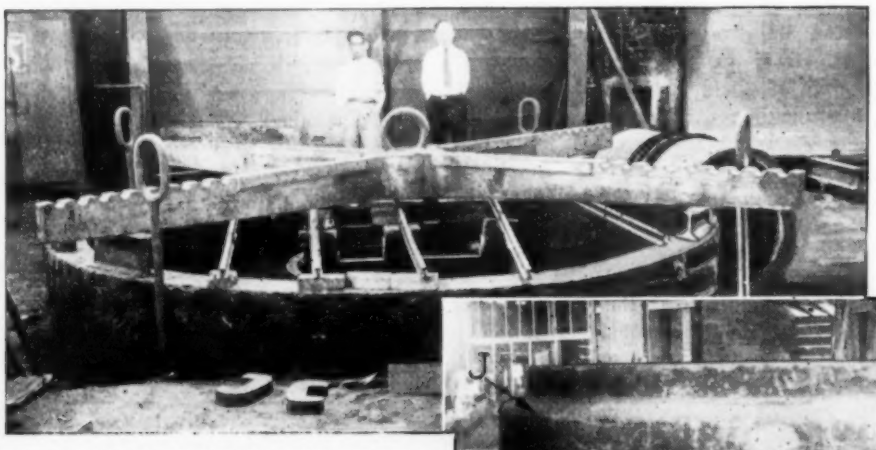


FIG. 1—THE OUTSIDE OF ONE OF THE LOAM MOLDS PARTLY RAMMED UP IN THE CASTING PIT

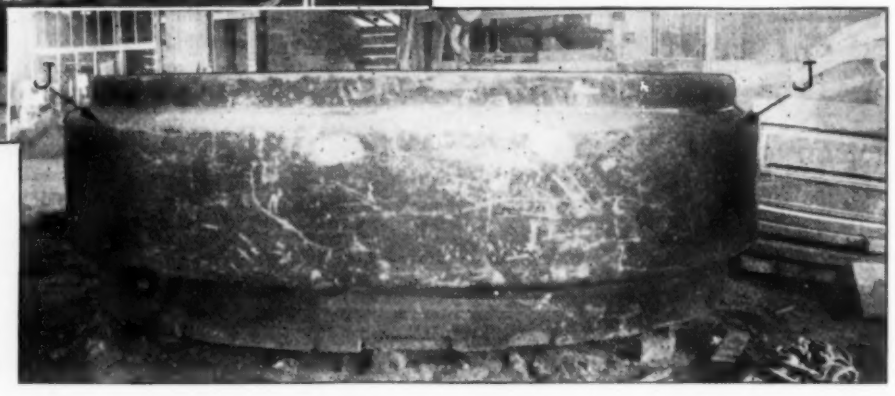


FIG 2—CORE FOR THE MOLD SHOWN TO THE LEFT. THESE CASTINGS ARE POURED THROUGH A NUMBER OF POP GATES SET ABOUT 9 INCHES APART AROUND THE ENTIRE CIRCUMFERENCE

The loam was even more unsatisfactory than the core sand. While we were standing in the vicinity of one of the ovens a car was pulled out on which was loaded a large loam core. It presented such an unusual appearance that I stepped on the car to examine it more closely and discovered that it had been bound around with strands of wire about every three inches apart. Between the strands of wire the loam had cracked and curled.

I was told that it was impossible to keep the loam on the bricks without the wire and the expense and loss of time involved in winding the wire around the core did not seem to bother any one. This particular core had been hauled out of the oven to be dressed and later after it had cooled a little I noticed several molders rubbing down the rough edges around the cracks. Then they washed it all over, daubed the cracks with loam, blacked it and shoved it back in the oven. It will be apparent to any foundryman of experience in this class of work that the foregoing was a dirty and disagreeable job for the molders engaged.

My claim that all these foolish precautions were not only unnecessary but were a waste of time and money was received by the molders with polite unbelief. They had heard claims made before many times. I realized that my future prestige and success in dealing with these men depended on whether I made good on my first promise. I am not a chemist qualified to make either a quantitative or a qualitative analysis of the sand. In fact, if I had had the analysis it would have meant nothing to me.

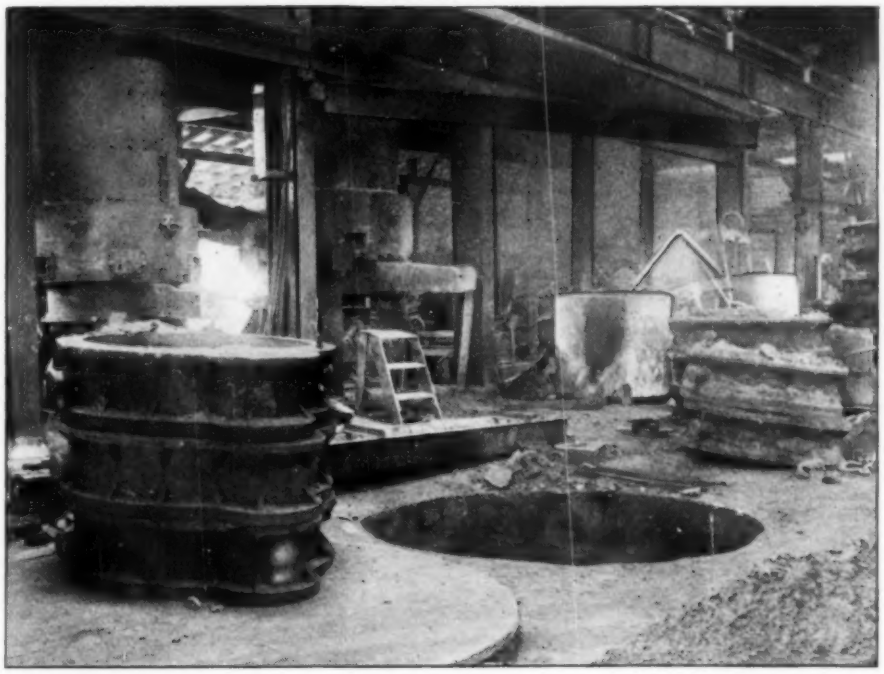


FIG. 3—ROLLS FOR CRUSHING SUGAR CANE ARE POURED IN THE TWO PITS ONE OPEN AND THE OTHER COVERED SHOWN IN THE FOREGROUND

However, practical experience in handling molding sand in many widely separated countries of the world furnished me with a basis on which to proceed and bore out the contention in the editorial to which I referred at the beginning of this article. An application of common sense on the part of a practical man is all that is required to solve many apparently mysterious phases of the sand problem.

Securing samples of the different varieties of sand used in the shop I examined them carefully both while they were wet and while they were in a dry state. I found the red sand to a certain extent similar to the sand found in the district around Alabama and other parts of the South. However, it was much closer and stickier and lacked the porosity peculiar to the Alabama sand.

Hard to Mix

On account of its wet and sticky character I found it impossible to mix this sand with old floor sand. It rolled into fine balls and refused to amalgamate. Then I had some dried and found that it dried as hard as a brick. If the foundry had been equipped with a grinding pan the work would have been greatly facilitated, but as it was not I had the hard sand pounded to a powder under a couple of pneumatic rammers and in that state it was incorporated in the various facing-sand, loam and core-sand mixtures.

The only other two varieties of sand available comprised a brown molding sand which contained an abnormal quantity of lime in the form of fine shells, and a sharp sand which had the same failing. On account of this high lime content the brown sand rarely was used.

To make a thorough test I decided to make up four different loam mixtures, apply them on the same core and compare results. The first batch was made according to the usual practice of the shop and was swept on to the core for one quarter of its area. In the second batch the quantity of red sand was decreased and the quantity of old floor sand, brown sand and sharp sand increased. This mixture was used to cover a second quarter section of the core's surface. The batch employed to cover the third section of the core contained a still lower proportion of red sand and a correspondingly larger proportion of each of the others. For the fourth section we mixed 3 parts of red sand; 3 parts of brown sand; 3 parts of sharp sand; 12 parts of old floor sand and 2 parts of dry manure. This was well mixed and riddled and was found to have sufficient bond to stick to the bricks and also finish up nicely.

A Satisfactory Core

The core was allowed to stand outside the oven over night so that I might observe the effect of air drying. In the morning I discovered that the first section was badly cracked; the second section was not so bad, the third section was passable, but the fourth section was entirely satisfactory. The loam was removed from the first three sections and replaced by a batch mixed according to the formula employed in the fourth batch. After the entire core had been swept and finished it was blacked and shoved into the oven. On the following morning when the core was hauled out it

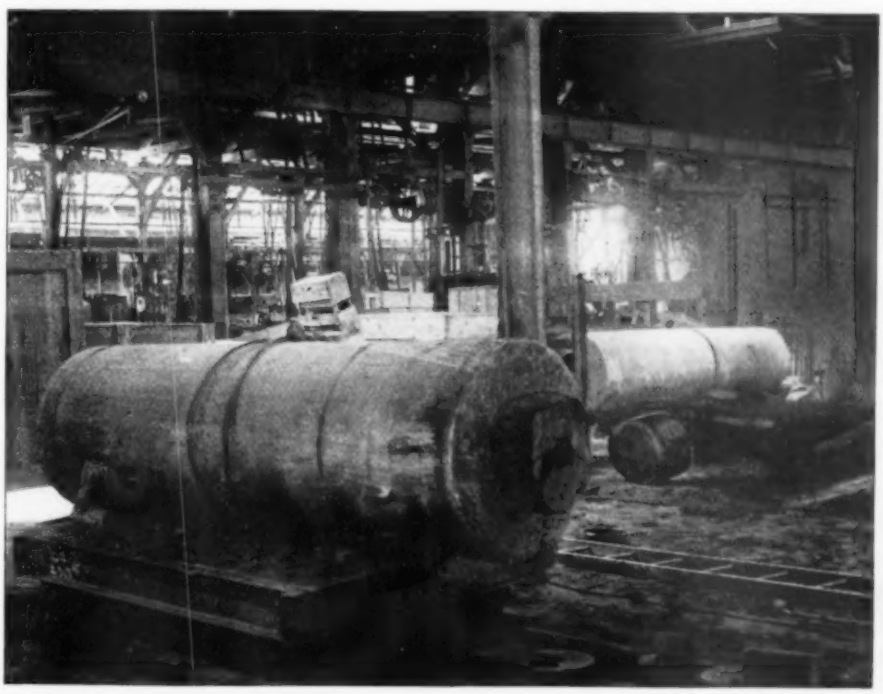


FIG. 4—THE ROLL IS POURED THROUGH THREE GATES, ONE NEAR THE BOTTOM, ONE ABOUT HALF WAY UP AND THE THIRD ABOUT A FOOT FROM THE TOP

was in as good condition as when it went in the preceding evening.

The dry-sand and loam molders gathered around and it was apparent from their actions that the appearance of the core was a revelation to them, but a revelation of which they highly approved. My interpreter assured me that I had created a highly favorable sentiment in their minds and that I need fear no opposition in any other innovations I might care to suggest or carry out. Perhaps it is pertinent at this point to remark that the casting in which this core was used cleaned up without a blemish inside or outside, in fact, the skin on the inside of the casting was as clean and smooth as the face of the mold in which it had been made.

We have used this loam mixture for over two years, varied a trifle occasionally for exceptional jobs, and in that time never have had a cut or a scab. The iron lays against it quietly where formerly it boiled and kicked all the time a mold was filling. The accompanying illustrations show some of the jobs on which the loam was used. No originality is claimed for the rigging or methods used in making the molds for this class of castings. Sugar mill machinery and appliances are made in many foundries in the United States as well as in many foreign countries and the practice is fairly well standardized. For the benefit of those who may not be familiar with this work a short description of each illustration may be permissible.

The large rolls used for crushing the sugar cane, one of which is shown in Fig. 4, are cast vertically in pits provided for that purpose. Two of these pits are shown in Fig. 3. One is shown open while the second is shown covered by a large round board. By referring to the illustration, Fig. 4, it will be noted that the roll is poured through three gates. One near the lower end, a second at the center partly concealed under the wire sling and the third about a foot from the top, or about at the point where later the head metal will be cut off. No copes are employed on these molds. The core is made considerably longer than the outside wall of the mold and is held in a central position by suitable cross bars and clamps while the mold is filling with iron. The iron enters the mold tangentially thereby assuming a whirling motion which prevents any foreign floating matter from sticking either to the sides of the mold or the core. Men armed with long iron rods stand on the floor in the immediate vicinity of the mold and closely watch the metal as it rises. Any slag or dirt that shows a tendency to linger behind is touched by the rod and kept moving. This practice has resulted in producing perfectly clean rolls.

The reservoir or tank shown at *A*, Fig. 3, is employed for pouring the rolls in these two pits. It is provided with a tap hole and short spout near the bottom. Two loops attached to the sides serve for handles by which it may be lifted from place to place. The jib crane shown attached to the column between the two cupolas is employed for shifting the reservoir and the runner troughs. Two of these runner troughs are used. A short one, not shown, for conveying the metal from the reservoir to the pit immediately in front of the cupola and a long trough partly shown behind the open pit and partly concealed behind the round flask resting on the wooden pit cover, for conveying the metal to the pit farthest from the cupola.

FIG. 5—THE UPPER RING ON WHICH THE LITTLE GIRL IS SITTING FORMS PART OF THE MOLD SHOWN IN FIG. 1. ON ACCOUNT OF THE SHOULDER ON THE CORE THE MOLD IS PARTED AT THE LINE INDICATED BY THE LETTERS *JJ* FIGS. 2 AND 6

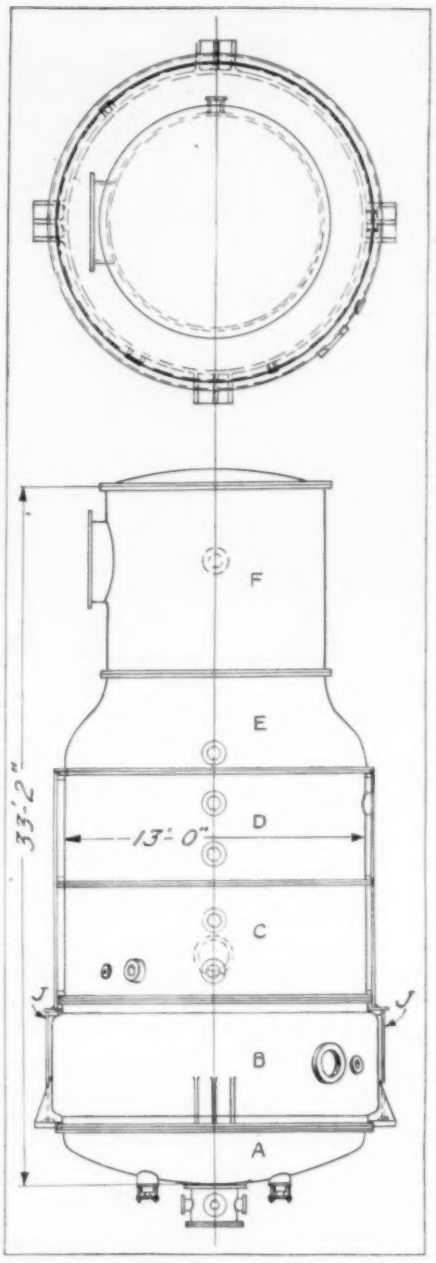


FIG. 6—EVAPORATOR UNIT USED IN THE MANUFACTURE OF SUGAR

The second bay of the foundry in which it is proposed to install a larger cupola is at present served with metal from the cupolas shown in Fig. 3. This bay of the foundry contains the drying ovens and also three large pits each 4 feet deep located close to the tracks leading to the ovens. One of these pits with a mold partly rammed up in it is shown

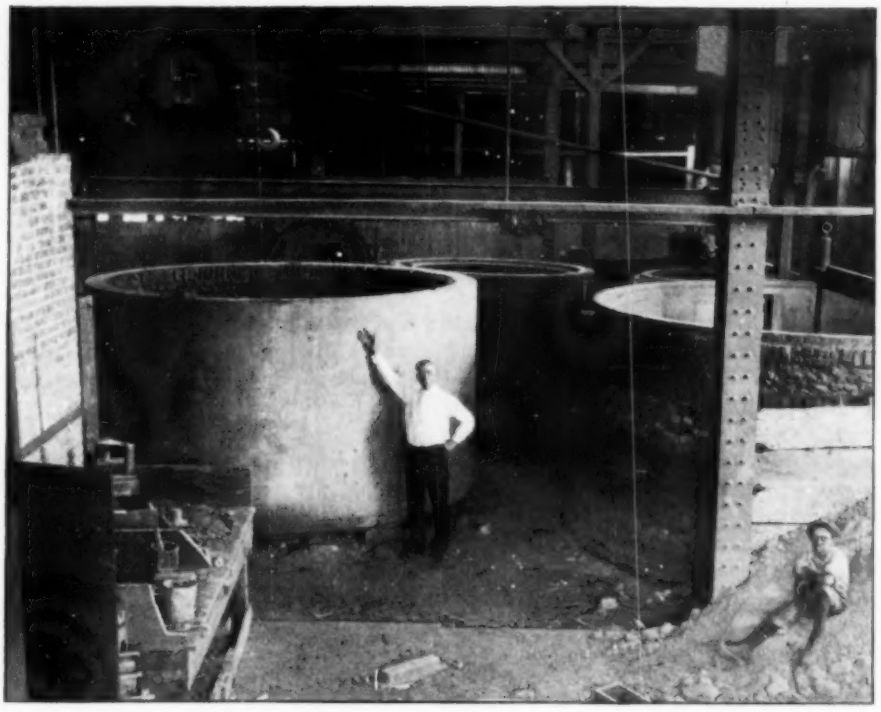


FIG. 7—INSIDE AND OUTSIDE PARTS OF THE MOLD FOR FORMING THE CASTING SHOWN AT *C* AND *D* IN FIG. 6

in Fig. 1. This mold is for a casting similar to that at *A* in the assembled set of castings shown in Fig. 6 known as an evaporator. In this connection it may be interesting to note that this vacuum apparatus is considered the most economical method for evaporating sugar solutions. It is claimed that it requires only one-third the fuel of the open kettle process and reduces to a minimum the loss from burning or inversion.

The apparatus may be arranged in multiple effect as shown or consist of one pan. More than three pans have not been found advantageous. These vessels are so controlled that the vacuum in the first is about five, in the second 15, and in the third 25 pounds, 30 representing a perfect vacuum. They are connected with a system of valves so that the juice may be drawn from the first to the second and from this to the third from which it is drawn into a syrup tank. Exhaust steam usually is employed for concentrating the juice, though it becomes necessary at times to use live steam. The steam enters the first and causes it to boil, the steam generated in this is sufficient to boil the second and so on. The concentration is carried to a density of 22 to 26 Baume or about 50 per cent water.

The cross shown for binding the mold in Fig. 1 is of the usual 4-arm variety and is fairly satisfactory. However, if I were making a new cross or a new set of rigging for this job I should make a 6-arm cross and make provision on the foundation and lifting plates for an equal number of lugs. The four points of the ordinary cross are too far apart on a big job and it frequently becomes necessary to supplement the cross by placing weights at various points or by adding clamps or extra binders on exposed points of the mold not covered by the cross. A 6-arm cross would obviate a great deal of this extra rigging.

Component Parts of Mold

The core shown in Fig. 2 is for the mold shown in Fig. 1. By referring to *J. J.* on Fig. 2 and the same letters on Fig. 6 it will be noted that on account of the shoulder at the point indicated it is necessary to make a parting in the mold along that line. The ring to form the part of the mold above the parting line is shown with the little girl sitting on it in Fig. 5. It has nothing to do with the mold on which it is shown supported. It merely was set on there temporarily.

The partly built mold for the casting marked *E* in Fig. 6 is shown in Fig. 5. As explained in the preceding paragraph the upper ring forms part of the mold shown in Fig. 1. The inside has been swept up, a false thickness swept on and covered with newspapers. As shown in the illustration the cheek lifting plate has been set and the first four courses of brick built up against the core. After the cheek has been built to the top it will be lifted off, blacked and dried. The thickness of sand corresponding to the proposed metal thickness of the casting will be swept off the lower part of the mold after which it also will be blacked and dried.

The inside and outside parts of a mold for a casting similar to that shown at *C* and *D* in Fig. 6 is shown in the illustration Fig. 7. They are swept up independently of each other, the spindle and spindle seat employed being of the type described on page 396 of the May 1 issue of THE FOUNDRY. The same covering plate is used on all these castings with the exception of the dome or catchall, *F*, Fig. 6. The two parts for a mold for one of these castings is shown to the right in the background of Fig. 7.

Safety Campaigns Apply to Foundries

PRACTICALLY all features of general safety work as carried on in machine shops and general industrial establishments apply equally well for foundries, according to G. E. Sanford, president of the American Society of Safety Engineers, who spoke before the New England Foundrymens' association, Wednesday night, Sept. 14. Mr. Sanford outlined the general principles of national safety work, and showed that many of these could be applied to foundries.

Safety work, said Mr. Sanford, primarily means common sense, and attention to the welfare of employes. Illumination should be considered from the standpoint of safety, because poor lighting means greater carelessness and eye fatigue. A man who has been working with inadequate light will be more likely to stumble over an obstruction on the floor, than one whose eyes have not been taxed, and of course shadows help to conceal obstructions, ventilation should be considered under the question of safety as well all things pertaining

to employes comfort. In a foundry, it is important to have cool core rooms, especially where the molders are women. One way of obtaining this is to surround the core ovens with an outer partition or wall, and connect the top with an exhaust fan.

Safety devices occupy an important place in safety work. These include guards for tools, eyeglasses and special screens and shields. It often happens that when a man is working at the bottom of a cupola, someone up above throws scrap or other material into the cupola with disastrous results. To overcome this, a protecting screen may be used, consisting of a circular frame work slightly smaller than the interior of the cupola, and carrying a heavy mesh screen. This may be supported in any convenient way by chain or rope, so as to hang a short distance above the operator's head.

It often is necessary for a man to walk near cupola spouts during the time of pouring and occasionally someone is burned by spattering iron. To overcome this, a shield has been devised to fit over the spout so as to reduce this hazard to a minimum. Proper clothing should be given consideration in any plant, and in a foundry shoes are especially liable to cause trouble. Lace shoes or low shoes offer an excellent opportunity for hot metal to lodge and burn through to the foot. The proper shoe is one which slips on over the foot without any lacing and which is fairly high.

Repairs Important

Attention to repair of equipment is important in keeping down accidents, according to Mr. Sanford. A case illustrating this is where a fastener holding up a heavy bale on a large ladle is so worn that the bale may slip off. In a Massachusetts foundry an accident of this sort happened, and the result was a broken leg. In any plant, the practice of carrying loads on cranes over the heads of men working on the floor should be avoided, and this is especially true in foundries, where there are many men continuously in the path of traveling cranes .

Sand blast equipment usually has its share of minor accidents and many devices have been placed on the market to overcome some of the difficulties. Fresh air has been introduced at the top of helmets but in the General Electric Co. foundries, this has proved a failure, as it has caused the operators to catch cold. The best practice at present seems to be a helmet of the usual design, with a thin gauze screen, and a respirator. Grids in the floor of sand blast rooms help to carry away sand and reduce the amount which is in circulation.

In chipping castings, screens should be used to protect those working in the vicinity. In some foundries, portable screens consisting of light frames with fine mesh wire have been used with good results. These may be moved to any large castings which are being chipped. Guards on belts and wheels should be placed wherever these come within the reach of operators. Grinding wheels too often have guards of insufficient strength. For a heavy wheel of 24 inches diameter, revolving at a surface speed of a mile a minute, 3/8-inch steel plate guard has been found to stand up when wheel breaks into pieces and to keep all such pieces within the case. Spectacles are a valuable protection to employes eyes, and yet this simple device is one of the most difficult to adopt successfully in a plant. There are innumerable cases where use of the proper kind of goggles have saved not only men's eyes, but their lives as well by catching steel particles.

In closing Mr. Sanford emphasized the fact that sanitation comes directly under the scope of safety work. The use of bubble fountains is recommended throughout foundries. Showers should also be available and it is advisable to have some sort of first aid equipment with a man, usually someone working on the foundry floor, in charge. In addition to this, in larger plants dispensary rooms help to reduce the serious effects of accidents. The chief item however, in all safety work is carefulness on the part of the individual and this is secured best through some sort of publicity or advertising which stimulates a cooperative spirit among employes.

British Foundry Exhibit Fast Taking Form

Preliminary arrangements for the exhibition of foundry and shop equipment and supplies which will be held in Birmingham, England, next year in conjunction with the annual meeting of the Institution of British Foundrymen, are making good progress. The date of the exhibition has been set for June 15 to 24, 1922. The show, which will be held in Bingley Hall, Birmingham, will be known as the International Foundry Trades exhibition. It will take place under the auspices of the Birmingham Chamber of Commerce. Bingley Hall is a large building specially erected for exhibition purposes. It has spacious exhibition rooms with suitable galleries for lighter exhibits. A natural dirt lower floor will permit the installation of heavy machinery. Various kinds of power will be available and it is expected to have cupolas and other melting furnaces in operation at the exhibition. The range of the exhibition will include all sorts of foundry equipment and supplies as well as equipment for machine shops, although mainly it will be a foundry show. Works management exhibits also will be featured. Special attention is to be paid to working exhibits. Facilities also are to be provided for showing motion pictures illustrating modern foundry and shop practice.

The cost of space has been tentatively fixed at 2s 6d to 3s 6d (46 to 65 cents) per square foot. The show will be under the general management of Charles Stanley of the Chamber of Commerce, 96 New Street, Birmingham. Mr. Stanley has been manager of several previous highly successful engineering exhibitions. Thomas Vickers, secretary of the British Cast Iron Research association, Central House, New Street, Birmingham, which association is also interested in the exhibition, and G. Henry Wright, will be secretaries. A strong committee of foundrymen representing the Birmingham, Coventry and other midland branches of the Institution of British Foundrymen, the British Cast Iron Research association, Birmingham Chamber of Commerce, etc., is being formed. The constitution of this committee will be announced shortly.

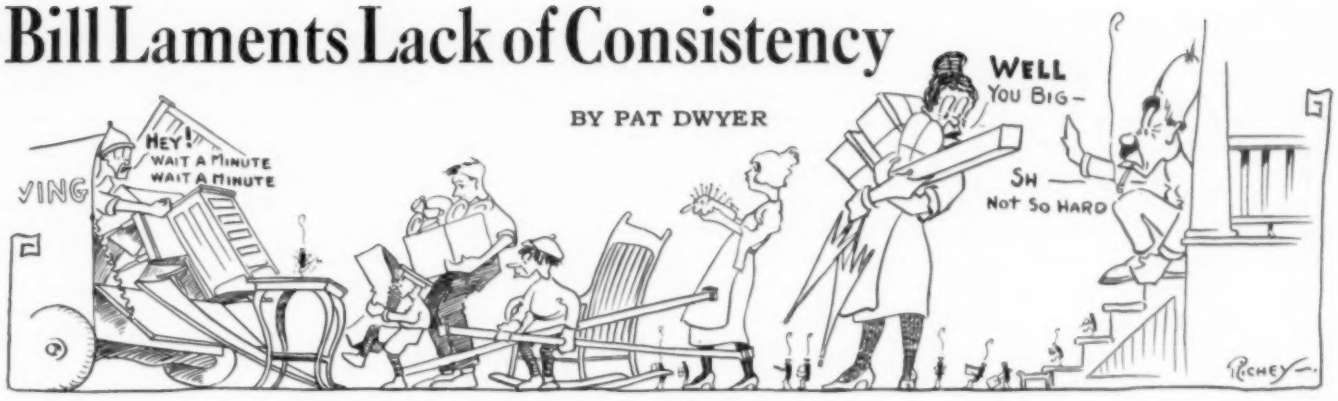
It is expected that the professional sessions of the Institution of British Foundrymen will be held near the exhibition hall and also that the Institute of Metals will hold meetings during the same week. It further is expected that local technical societies such as the Birmingham Metallurgical society; the Staffordshire Iron and Steel institute; the Midland Ironfounders association, etc., also will hold meetings during this week, which it is planned to make a foundrymen's week for Great Britain and Europe.

Slag Article Corrected

The following corrections should be made in the article "How Slags Affect Cupola Operations," by J. W. Bolton, published in THE FOUNDRY, Sept. 1. In Table I the figures indicating the amounts of CaO and MgO in fluorspar should be in the line above, under limestone. The decimal points in two figures in Table V, indicating sulphur in iron should read .109 and 0.05, respectively. On page 676, column 2 the reference are to "General Metallurgy" by Hokman, and to the U. S. bureau of mines publications by other authors.

Bill Laments Lack of Consistency

BY PAT DWYER



SO FAR as I have been able to discover in the many years we have lived together, the lady who at one time promised to love, honor and tolerate me, has only one fault. I do not mention this in a carping or critical spirit for usually she exhibits an even and gentle disposition and frequently points to the fact that she married me as an evidence of how easily she is pleased. She is descended from a proud old highland clan which never wavered in its allegiance to the House of Stewart and whose members either through force of circumstances or through love of adventure have upheld their honor at the sword's point for centuries on every battle field and in every capital of Europe.

This fault, of which I speak with all due respect and circumspection, probably is hereditary and due in some measure to the roving habits of these gallant gentlemen of fortune who after Culloden were forced to fly from their native land and seek a home among a strange and alien people. Whatever the reason, the fact remains that she never has been satisfied in any of the houses in which we have lived.

Some people might not consider this a fault and it goes without saying that I never have referred to the question in that light, but strictly between ourselves as one mere man to another, I hate the idea of moving from one house to another. Having given the matter due consideration I am forced to the conclusion that in addition to circumstances and hereditary influence one must have a special gift to become a satisfied and successful mover. There are occasions when the landlord becomes a potent factor in deciding whether to move or not and it may be that we shall have to reckon with that factor in the future, but up to the present we have, as the saying goes, beat him to it and got out without waiting for the formality of an invitation. Another point worthy of consideration, although it is an open question whether it has any direct bearing on the subject or not, is whether the wise old gentlemen who composed the copy book headlines knew what they were talking about or whether they were, in the vulgar phrase, talking through their hats.

If your memory is in good working order and if you are old enough, probably you can see yourself with a pen clutched in your grimy little fingers, tongue hanging out one corner of your mouth and both feet desperately locked around the foot of the bench, trying vainly to copy the words, "Habit Is Second Nature." As a headline for a copy book, the phrase is all right and I have no fault to find with it, even though I never could, either then or down to this day, make a presentable capital letter S. But taking the sentence as a statement of fact, I consider it altogether too sweeping. There should be a qualifying clause or two tacked on to it. For instance if it read, "Some habits are second nature to some people," I should support it unanimously and without reservation.

Taking the original statement as it stands I say—Pooh! also Bah! The years that intervened between the day I finished serving my time in the foundry and started serving my time in the matrimonial business, I spent in joyously flitting over this broad land from town to town and from boarding to boarding house. Consequently, if the proverb meant anything it meant that I had developed the habit of moving and could no more think of staying in one place than a gypsy.

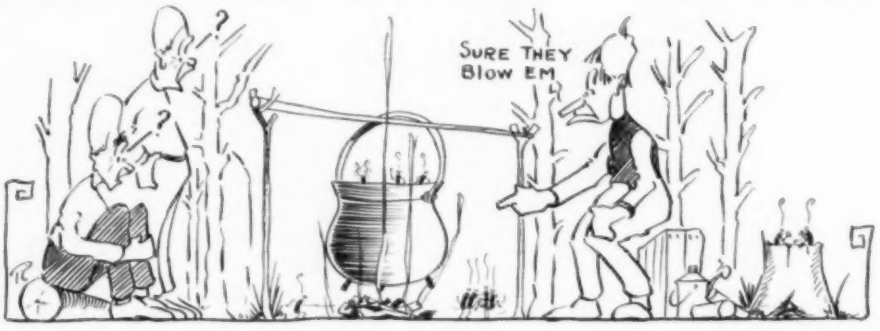
What are the facts in the case? The facts briefly are what every person has experienced at one time or another, too much of a good thing is worse than none. If I had my way I never would move. I never saw anything wrong with any of the houses in which we have lived for varying periods and willingly would have remained in them; but after the first month I never yet have seen one that pleased the lady. In all justice and fairness I must admit that each time after she had picked out a new house and had made arrangements to move she gave me the option of remaining in the old house if I liked it so well, or of going to the new house with the remainder of the furniture. Last Saturday afternoon she announced that in looking over the

MOVER'S LICENSE SHOULD INCLUDE PRIVILEGE OF WINGING THE LANDLORD

advertisements of houses for rent she had noted one that would meet her requirements. However a personal inspection would be necessary and in the tone of one conferring a favor she intimated that she would be pleased to have my company on the journey. The address given was in a part of the city with which she was not familiar and I warned her that probably she would not like the house after she had seen it. I might have saved my breath. She said that if I did not want to go all I had to do was say so and she probably could find the place by herself. If there was one thing she hated more than another it was a dog in the manger and anyhow I had better hurry and get ready because it looked like rain and she did not propose to stay out all day.

Having reached our destination I pointed to the house and then at the risk of being ostracised, excommunicated and black beaned I said "Ha, Ha!"—just like that. At first she refused to believe that we were on the right street, but after I had shown her the name on the corner she said things about the man who had written the advertisement that must have made his ears burn. Being a perfect lady she could not express herself openly in the manner which the occasion warranted, but it so happens that she is an expert on silent prayer and years of close association and diligent study on my part have made me something of a mind reader so that I shuddered at that landlord's ultimate fate.

On the way home at my suggestion we stopped in at Bill's place for an hour or two to pay a friendly visit. The ladies immediately went into executive session over a pot of tea, each one talking as fast as possible, while Bill and I sat on the veranda and smoked the pipe of peace. I went over the events of the afternoon for his benefit and like the good old scout he is, he congratulated me warmly, although in a guarded voice upon the exquisite pleasure I must have derived from being able to say "Ha-Ha" at the proper moment.

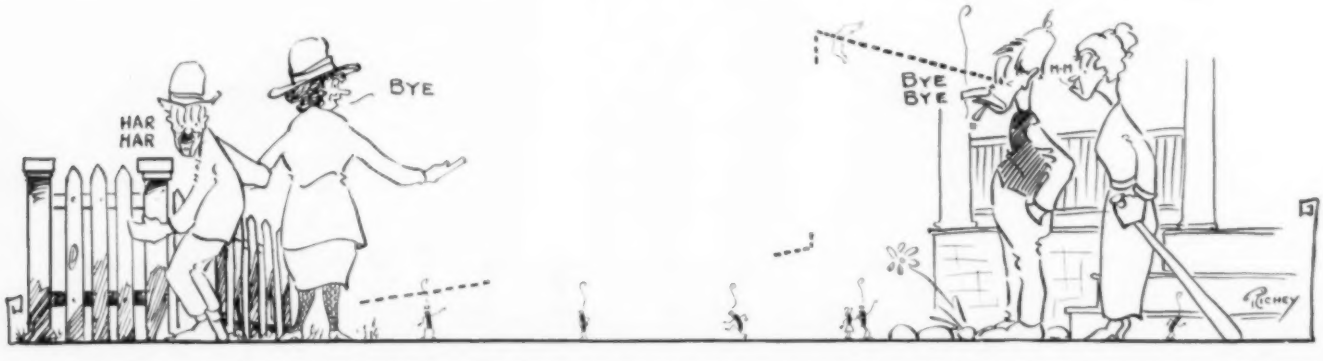


CAMPING CLOSE TO NATURE'S HEART, MEN NATURALLY TELL THE TRUTH

"They are all alike" said he "You can't please 'em no matter what you say or do and they always are asking the most embarrassing questions in the most innocent manner. For instance, with the possible exception of Eve, there never has been a woman who did not at one time or another ask her husband if he would marry again in the event of her death. If he answers absent mindedly that perhaps he might, she is convinced that he has another lady in mind and is only waiting for her to let go the string of life. She immediately proceeds to register the most poignant grief tinged with annoyance to a greater or less degree depending on her temperament. On the other hand, if he wakes up at this point and in a desperate endeavor to repair the damage and smooth things over says 'I should say not, no sir, never again' she thinks she is perfectly justified in assuming that he never has loved her and you know what old Bill Shakespeare says about a woman scorned.

"However, women are not the only people who ask embarrassing questions. I have in mind now people who ask questions that could not be answered even sketchily in less than 10,000 words and yet they cannot see why the answer cannot be boiled down to about 50 words for their benefit. I was out camping with a party last summer and among the cooking utensils was one of those little round-bellied, three-legged, cast-iron pots and in one of those aimless desultory conversations that spring up around a camp fire at night some one wondered how the thing was made. Finally one of the gang appealed to me. 'Say Bill' said he 'You do some thing around a foundry, don't you? How are pots made?' I told him there were many kinds of pots including fire pots, tea pots, jack pots, jam pots, hot pots, pot luck, pot pie, pot shots, pot-pourri, Mrs. Potts who invented the sad iron, the pot bellied spider referred to so playfully by the late Mr. Dickens and the mythical pot of gold at the end of the rainbow besides a few which I could not recall just at the moment. If he wanetd me to enlighten him on all these varieties, he had better telegraph the old man to extend his vacation a few weeks.

"He said he was not interested in any of them, neither had he any desire to spend the remainder of the night listening to a long winded oration, but if I knew any thing about it and would describe the process used in the manufacture of cast-iron pots he would listen patiently for a few minutes. He did not use these exact words. In fact to be strictly truthful he said 'Ah, cut out the bunk, if you know anything about a pot, spill it, and for heaven's sake make it snappy.' Can you beat that?



ALL THINGS COME TO HIM WHO KNOWS HOW TO WAIT EXCEPT A LADY WHO STARTS TO SAY GOODBYE

"Far be it from me to stand in the way of a man earnestly seeking the light. You know we are all poor pilgrims in this vale of tears and should let no day pass without rendering a kindness to a brother, so I told them that the pots were blown with compressed air. It is a secret process, jealously guarded by the foundrymen, but I felt we were all friends together and I knew I could rely on their discretion to keep whatever I told them tightly locked in their own breasts. When they left the camp and returned to their respective homes, I admonished them to avoid all talk or controversy touching on the details of the manufacturing process which I proposed to lay before them.

"With a few minor changes in the equipment due to the difference in viscosity between iron and glass while in a molten condition the method is the same as that pursued in the manufacture of glass bottles. It so happened that a magazine brought to the camp with the other supplies contained a brief description of glass bottle making so that in using that for an illustration I knew I was treading on familiar ground.

"I told them that in the older establishments the molten iron was dipped out of a pot by long handled dippers and spilled into the molds, but in the more modern and up to date plants the molds were set in a long row in front of the melting furnace. A length of pipe connected to the furnace at one end and terminating in a faucet at the other end serves to convey the metal from the furnace to the mold. The man operating the battery of molds turns the faucet and allows a definite quantity of metal to flow into the mold. The amount is automatically determined by a scale on which the mold is mounted and which sinks a certain distance as soon as it contains the necessary amount of iron.

"When the iron enters the mold it is practically as fluid as water and therefore in no condition to be manipulated. It is allowed to stand for a few moments until it has congealed slightly or until it has assumed the same viscosity as molten glass under the same conditions. A jet of compressed air then is introduced at the bottom and the soft and plastic material is forced against the interior surface of the mold. Besides forcing the metal against the inside surface of the mold and thereby giving it a definite shape, the air exerts a cooling effect which greatly facilitates the rapid production of these little cooking utensils. In fact the action is practically continuous. Two men usually attend a battery of molds. One man comences at the end and introduces the molten iron to the molds. By the time he has reached the other end the second man has commenced turning on the air jets and removing the finished articles.

"At this point I paused to note the effect of this string of misinformation fully expecting that some person would ask a question or two that would blow my story to pieces, but do you know, those apparently intelligent men had seen nothing absurd about it. One of them said that he always had felt that the process must be rather simple because you can buy one of these little pots for about four bits. A second said that he often had wondered how these pots were made. He could understand how the outside might have been formed but he never had been able to figure how they were made hollow on the inside, nor how the metal was kept to such an even thickness. However, after my explanation he realized the simplicity of the process and wondered that the idea never had occurred to him."

"Do you mean to tell me", I said "that you left them with that impression, that you did not give them a proper description of the foundry methods involved in the production of this class of castings?"

"There you go again," said he, "You are the same as the rest of them. You ask an involved question that a man can answer neither in the affirmative or the negative. The only way to answer it is to say yes and no and if I said yes and no it is ten chances to one that you would come back with 'yes and no what?' You would have forgotten the form of your question and would wonder that I did not answer you more intelligently. However, although the form of your question does not deserve such consideration I'll answer it so that with out peradventure of a doubt you will exactly understand my attitude in this matter.

"To the first part of your question I am thankful to say I can return a cheerful affirmative, and why not? What a man does not know never will do him any harm. To the second part I can return an equally cheerful negative. Why should I waste my time handing out precious technical information to a number of men who knew little and cared less about the technique of the casting of metals. If they had been members of the ancient and honorable community of iron founders, familiar perhaps with some branches of the art and seeking information on a branch with which they were unfamiliar I should have esteemed it a pleasure and a privilege to impart what knowledge I had to them, but as it was, the information I gave them was of just as much service to them as if I had gone into the most intimate details of actual foundry practice.

"While it is true that pots are made in molds and poured with molten metal in the foundry, thus sharing the characteristics of other castings, still the methods employed in their manufacture differ in many ways from that employed on many other castings and for that reason present many points of interest. Again, large pots are not made in the same manner as small pots so that a description of the manner of molding one would not apply in the slightest degree to the other."

"Your intentions are all right Bill" I said "but I am afraid I cannot wait to hear any pot story today. I am neither a prophet nor the son of a prophet but basing my belief entirely on the sound of a pair of smart little feet tripping down the hall way I should say that I am due to say good bye in about 14 seconds by any accurate and reliable time piece."

"Don't worry" said Bill, "Some of this dope on the subject of pot molding has been in my mind for a good many years without spoiling and I guess it will keep until I see you again."

Foundrymen Open Season in New England

The fall season for the New England Foundrymen's association started Wednesday, September 14, with a dinner and evening discussion devoted to the subject of safety as it applies to foundry practice. G. E. Sanford, safety engineer of the General Electric Co., and president of the American Society of Safety Engineers talked on foundry hazards and safeguards. M. M. DuChemin, secretary of the Lynn works safety committee, presented a paper entitled "Selling Safety."

The New York federal reserve bank computes that the fall in prices in 11 countries including the United States from high in early 1920 to latest available statistics ranges from 58 per cent in United States to 24 per cent in Italy, average being about 42 per cent.

THE FOUNDRY

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Contents

	Page
How Ford Cylinder Blocks Are Cast	751
British Foundrymen Hold Postponed Meeting	758
Discusses Problems of the Foundry	759
Research Improves Malleable Castings	761
Crank Cases Made In Malleable Iron	762
Grinding Manganese Steel Castings	767
Shows Heavy Decline in Foundry Employment	771
Hoosier Foundry Ends Century of Service	771
Melts Metal for Pipe in the Mold	772
How and Why in Brass Founding	774
Bad Metal Expensive	774
Mixture for Bearing	774
Recommends Changes in Valve Patterns	774
Solders and Fluxes for Use With Aluminum	775
Causes of Porous Spots	775
Brass Mixture for Use in Spark Gap Spheres	775
Formula for Monel Metal	775
Loam Molding Presents Difficulties	776
Safety Campaigns Apply To Foundries	779
British Foundry Exhibit Fast Taking Form	780
Slag Article Corrected	780
Bill Laments the Lack of Consistency	781
Foundrymen Open Season In New England	783
Foundrymen's Associations Resume	784
Trade Outlook in the Foundry Industry	785
Personal	786
Obituary	786
Paris Office Opened	786
Germans Hold Foundry Exhibition	786
Pittsburgh Foundrymen Meet	786
Launch Schools To Teach Industrial Publishing	786
Heavy Scrap Is Cut With Oxyacetylene Flame	786
Crawling Tread Crane Has Gas Engine Power	787
New Dressing for Burns	787
Develops Compensating Pyrometer	787
Designs Double Eyepiece for Microscopes	788
Many Materials Used for Foundry Floors	788
Equipment Buying Improves Slowly	789
What the Foundries Are Doing	790
New Trade Publications	790

Foundrymen's Associations Resume

WITH the return of cooler weather the various foundrymen's associations of the great casting centers are resuming activity along the lines for which they primarily were organized. Excepting an occasional day or night set apart purely for recreation, these associations usually discontinue their monthly meetings some time in June and resume again in September. Of course, one reason for this is that the greater number of the members of these organizations take their vacations in July and August and therefore the meetings scheduled for these two months would be poorly attended. Another reason is that the average man has little inclination to remain indoors or attend a meeting during hot weather.

The purpose of these associations in their monthly meetings, the interchange of experience and discussion of foundry problems, is admirable and cannot fail to add to the information of the members individually and reflect on the advancement and improvement of the industry.

The custom of inviting a speaker to address the meeting on some special topic connected with the foundry industry has met with favor by the different associations, but the benefits to be derived from such practice is minimized to a certain extent by the apparent backwardness of the members as a whole to participate in a discussion of the subject matter of the speaker's address. This inertia is common to men when assembled in public meeting, not because they are not qualified or interested, but because they seem to take it for granted that they are fulfilling their duty by simply attending the meeting and listening with more or less polite attention to the speaker of the evening. Again, the average man while fluent enough in the presence of one or two cronies suffers from stage fright when in the presence of a crowd and seems to think that because he is not a natural born orator his efforts will make him appear ridiculous.

It should be the earnest endeavor of the officers of the association to dispell these mistaken ideas and to encourage the members to take an active part in all discussions. The usual method, in which the chairman at the close of the speaker's address announces that the meeting is now open for discussion and any member who wishes to ask a question is free to do so, usually is negative of results.

One method of overcoming this diffidence and creating interest in the meeting is for the chairman to advise certain members in advance of the subject for discussion and intimate that he expects each one to come prepared to take part in the discussion at the ensuing meeting. Again the chairman at the close of the speaker's address may call on several members specifically by name to comment on the subject or to ask a question.

Impress on each member that the greater amount of total information contributed at each meeting, the greater will be the amount absorbed and taken away by each individual member. The organization was formed and is being maintained for the mutual interchange and dissemination of information on a subject in which every member is interested and therefore each should cheerfully contribute his quota whenever opportunity offers.

Trade Outlook in the Foundry Industry

EVIDENCES of improvement, slow but steady, continue to be evident in practically all branches of the foundry industry. Although the increase in volume of orders for castings is not appreciable and in normal times would be taken as no indication of better business, the upward trend is marked and a comfortable feeling exists that the worst of the depression is left behind. The worst period of dullness was coincident with the normal slack season of the year, and with the approach of winter a steady increase in business is anticipated.

Stocks Are Low

Pig iron sales, the most accurate barometer of conditions in the castings industry, show a steady gain. Furnaces again are being relighted to make iron due on contracts which have remained dormant during the past several months. In practically all sections, foundry stocks of iron and fuel are fast diminishing despite the low schedules of operations which prevail. The production of iron and coke alike has been below the curtailed consumption, as is clearly indicated by the steady pickup in sales and the increase in inquiry for last quarter delivery. The price question is receiving much consideration from foundrymen. The past few weeks have indicated that present prices are stable and no further recessions have been noted. Some expect the longed-for freight reductions to exert some influence in this direction. Pennsylvania, New York and New Jersey pig iron producers recently asked for relief from the present high rates on ore, coal, coke, limestone and refractories. However, furnace interests question the probability of expected freight reductions exerting a great influence downward upon pig iron prices.

Prices of Raw Material for Foundry Use

CORRECTED TO SEPT. 22

Iron		Scrap	
No. 2 Foundry, Valley	$21.00	Heavy melting steel, Valley	$13.50 to 14.00
No. 2 Southern, Birmingham	19.00	Heavy melting steel, Pitts.	13.50 to 14.00
No. 2 Foundry, Chicago	22.00	Heavy melting steel, Chicago	11.50 to 12.00
No. 2 Foundry, Philadelphia	20.35 to 21.25	Stove plate, Chicago	14.00 to 14.50
No. 2 Foundry, Buffalo	19.50 to 21.00	No. 1 cast, Chicago	14.50 to 15.00
Basic, Valley	19.00 to 20.00	No. 1 cast, Philadelphia	16.50 to 17.50
Basic, Buffalo	19.00 to 20.00	No. 1 cast, Birmingham	16.50 to 17.50
Malleable, Chicago	22.00	No. 1 cast, Buffalo	16.00 to 16.50
Malleable, Buffalo	20.00 to 21.00	Car wheels, iron, Pittsburgh	15.50 to 16.00
Coke		Car wheels, iron, Chicago	15.00 to 15.50
Connellsville foundry, coke	$4.25 to 4.75	Railroad malleable, Chicago	15.00 to 15.50
Wise county foundry coke	6.50 to 6.75	Agricultural mal., Chicago	15.00 to 15.50
		Railroad malleable, Buffalo	13.00 to 13.50

Car Inquiries Improve

Railroad car builders now have inquiries pending for about 8500 cars according to estimates. About 5000 of these will be for domestic and 3500 for foreign service. In addition about 1500 mine cars probably will be contracted in the near future. Car repair orders still continue to furnish a fair volume of business to the steel and malleable foundries which specialize in this class of work. Car wheel shops, in general, are working at less than 50 per cent of capacity and mainly on replacement orders. Despite the light buying of railway equipment which brings business to the foundries, confidence is expressed that the railroads soon will be able to enter the market and build up their motive power and rolling stock to a point which will enable them to handle the winter's demands. The margin between idle and bad order cars is exceedingly small and the freight movement steadily is increasing. The first week of September showed a decrease of 8768 in the idle car figures, the daily average surplus to Sept. 8 being 237,972 as against 246,740 cars for the period from Aug. 23 to 31. Further, the financial status of the railroads is slowly strengthening, as is evidenced by the sale of railroad equipment certificates, offered by the treasury department against the car trust issue of $380,000,000. This fund will provide means for paying past due equipment accounts and will enable the railroads to extend their credit for further purchases. Many foundries handling direct railway work again are optimsitic.

Operations Spotted

If the percentage of foundry operations throughout the country were computed, the average likely would be low. Despite the upturn, the increase in inquiries and the better conditions in many lines, the castings business is irregular. Pipe shops still are active, the private demand and odd lots of small tonnages serving to hold up the general average. Some pipe plants have orders sufficient for 60 days continuous operation. Stove foundries, also, are favored and the larger plants in the Mississippi valley are fairly busy. The Southern Stove Manufacturers association which met in Chattanooga, Sept. 21, predicted an average demand throughout the fall and winter and reported slowly increasing production. Canadian stove foundries, too, are fairly busy and note a much more active buying interest. Jobbing shops, particularly those handling municipal castings and miscellaneous construction castings are operating on better schedules, and prices are slightly stronger, although some medium weight gray iron castings recently were contracted in the Cleveland district at $70 a ton. Implement manufacturers except in a few instances are not buying, and consequently foundries supplying this class of work are inactive. Textile machinery makers are buying castings and consequently many of the New England foundries are fully engaged.

Brass Shops Pick Up

Nonferrous foundries, in general are on the same basis as the other castings plants of the country. The plumbing goods shops constitute a a notable exception and according to the National Association of Brass Manufacturers, which met recently, their operations will average above 60 per cent, with August showing a substantial gain. Nonferrous metal prices according to New York quotations in the *Daily Metal Trade* of Sept. 22 follow: Casting copper, 11.75c; electrolytic copper, 12.25c; lead, 4.65c to 4.70c; Straits tin, 26.75c to 27.00c; aluminum, No. 12 alloy, producers' price 23.80c to 24.00c and open market, 14.00c to 16.00c. Zinc is 4.17½c, E. St. Louis.

Personal

F. V. Archer, formerly manager of Naumberg & Co., New York, has been elected vice president of the Thacher Propeller & Foundry Corp., Albany, N. Y., having charge of finance, costs, expenditures, etc.

Walter G. Bunzel, formerly chief engineer of the Richmond Radiator Co., is now connected with the Pittsburgh Electric Furnace Co. at its New York office.

J. Grennan, formerly connected with the foundry department of the University of Illinois, Urbana, Ill., has been appointed instructor in foundry practice at Michigan university, Ann Arbor, Mich.

John D. Hurley, president of the Independent, Pneumatic Tool Co., 600 West Jackson boulevard, Chicago, manufacturers of air and electric tools, arrived in New York on the S. S. NEW AMSTERDAM, Sept. 9, following a six weeks' trip abroad.

J. D. Wise has been appointed superintendent of the foundry department, University of Illinois, Urbana, Ill. Mr. Wise formerly was connected with the Osborn Mfg. Co., Cleveland. Plans are being made to extend the foundry course to a full year instead of one-half year as at present.

E. H. Dean, manager of the Fitchburg, Mass., office of the American Radiator Co., has been transferred as manager of the Worcester, Mass., district office, succeeding William M. Tuttle, promoted as assistant to the New England manager with headquarters in Boston.

F. A. Emery, of the London, Eng., office of the Norton Co., Worcester, Mass., will act temporarily as foreign manager pending the selection of a successor to Vice President W. La Coste Neilson, who has been transferred to the home office as general sales manager to fill the vacancy caused by the recent resignation of Carl F. Dietz.

Obituary

Matthew M. Sweeney, secretary and general manager of the Fairmount Foundry & Engineering Works, Woonsocket, R. I., of which he was one of the incorporators, died at his home in that city, Sept. 7, aged 43 years. He was a native of Woonsocket, a graduate of Brown university, Providence, R. I., class of '09, and had been connected with the corporation since it was incorporated in 1917. He was a member of the American Society of Mechanical Engineers and various Woonsocket organizations.

Takes Over Aetna Plant

Cleveland investors have organized the Ohio Steel Castings Co. to take over the Cleveland plant of the Aetna Steel Castings Co., 2284 Scranton road S. W., which went into bankruptcy about six months ago. The Aetna also has a plant in Lorain.

The Ohio Steel Castings Co. has been incorporated under Ohio laws. Incorporators are, John W. Thompson, president and treasurer; Dr. C. S. Fenton, vice president; Harry Greshen, general manager; John A. Elden, secretary and counsel W. I. Thompson.

Paris Office Opened

AS A forward step in its policy of rendering the most complete service to the foundry industry throughout the world, THE FOUNDRY *has established an office at 224 Rue de Rivoli, Paris, France in charge of its French correspondent and under direction of its European headquarters at 2-3 Caxton House, Westminster, S. W. 1, London. The facilities of the office will be available at all times to those identified with the castings industry and allied interests.*

Germans Hold Foundry Exhibition

In connection with the 51st annual meeting of the Verein Deutscher Eisengiessereien Giessereiverband, Düsseldorf, Germany, the second foundry exhibition was held in Exhibition Park, Munich, Sept. 14-25. Besides the various kinds of machinery, ovens and furnaces, tools and accessories, etc., used in the casting industry there, a collection of art castings was exhibited. The Verein Deutscher Giessereifachleute, the Verein Deutscher Stahlformgiessereien and the Gesamtverband Deutscher Metallgiessereien met in Munich at the same time.

Pittsburgh Foundrymen Meet

The first monthly meeting of the 1921-22 season of the Pittsburgh Foundrymen's association was held Sept. 19 at the General Forbes hotel. The meeting was featured by the presentation of a 3-reel film prepared by the United States bureau of mines at the plant of he American Rolling Mill Co., Middletown, O., dpicting the story of "Ingot Iron."

Launch School To Teach Industrial Publishing

Arrangements have been completed by the New York Business Publishers association, New York, for a course of study in industrial publishing, for the staffs employed on publications issued by its members. The entire course will last eight or nine months, classes being organized this fall, probably in New York, Chicago, Boston, Philadelphia, Cleveland and St. Louis. The study unit plan which combines home study and weekly class meetings will be used. Instructors are to be men engaged on industrial papers so the instruction will be practical. Texts are being prepared by publishers, editors, business managers, and service department managers. The outline for the course is divided into 15 units and five sections. The topics which will be studied as units are the field of industrial publishing, organization and personal requirements, editorial contents, editorial methods, preparing editorial material, writing for industrial papers, production technique, circulation building, creating advertising, handling correspondence, accounts and collection, departmental management, service to the industry, service to advertisers, ethics and policies.

Heavy Scrap Is Cut with Oxyacetylene Flame

Six 12-inch mortar carriages, part of the equipment in the fortifications protecting Long Island sound, recently were sold by the government for scrap and removed to a New London scrap yard. The guns originally mounted on the carriages were remodeled for use with mobile artillery during the war.

Many of the sections are heavy and cumbersome and the purchaser experienced considerable difficulty in reducing the castings to portable size. At first he tried blasting with dynamite, but the method did not prove satisfactory owing to the labor and time involved in moving the unwieldy metal sections from the concrete battery positions to the open fields in which the blasting took place. Besides there always was

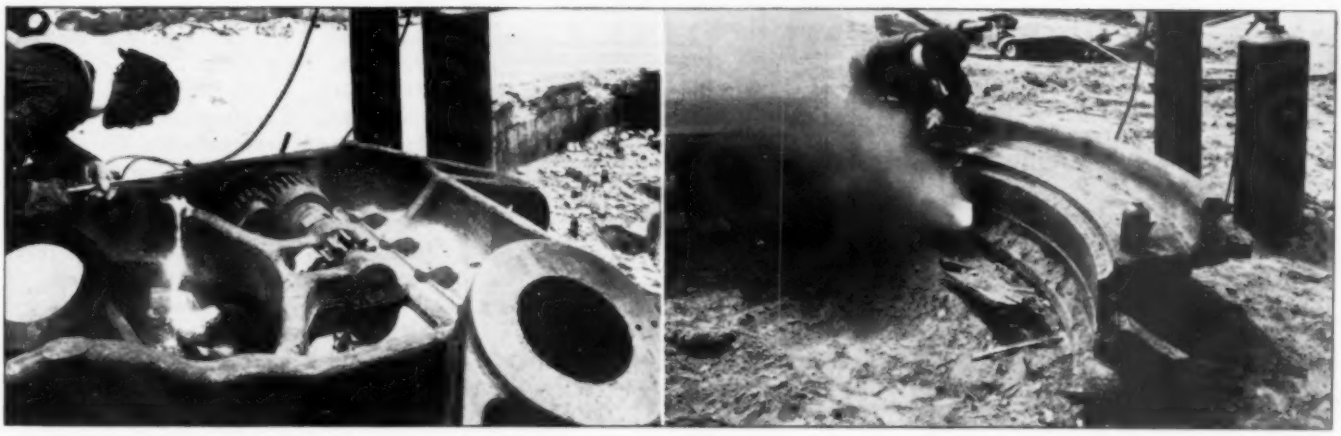


FIG. 1—WHAT OFTEN HAPPENS WHEN FINIS IS WRITTEN ON THE SERVICE OF UNCLE SAM'S FIGHTING TOOLS. FIG. 2—THE OPERATOR SHOWN MADE A CUT THROUGH THE CAST IRON SECTION IN LESS THAN 15 MINUTES

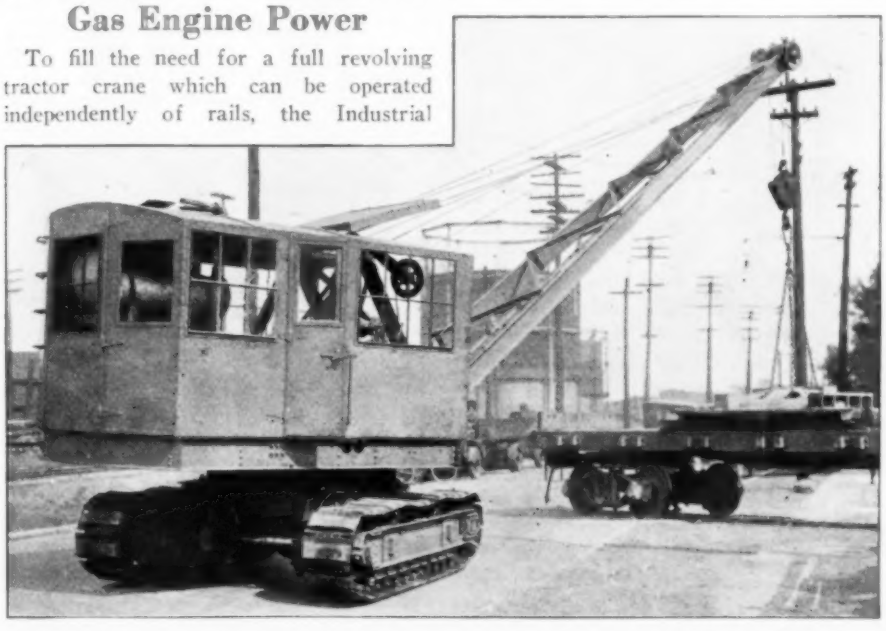
the danger of hitting passing soldiers with flying pieces of metal.

In response to an invitation from the purchaser an expert cutter of the engineering service department of the Air Reduction Sales Co., New York, gave a demonstration of the possibilities of the oxyacetylene torch in cutting metals, including cast iron. As a result of the demonstration, the use of dynamite has been discontinued and the oxyacetylene torch utilized to cut up the remainder of the scrap. The operator shown in Fig. 2 made a cut through the cast iron section in less than 15 minutes. If the torch had been adopted in the first place the cutting could have taken place inside the battery emplacement as easily as outside and the heavy casting could have been reduced to portable size without moving it a considerable distance beyond the emplacement.

Crawling Tread Crane Has Gas Engine Power

To fill the need for a full revolving tractor crane which can be operated independently of rails, the Industrial Works, Bay City, Mich., has developed a new crane which is built in two types. The larger type, which is shown in the accompanying illustration, has a capacity of 20,000 pounds at 12 feet radius and is equipped with continuous crawling tractor belts while the smaller type has a capacity of 18,000 pounds at 10 feet radius and is equipped with four wide gage tractor wheels. Both types are well adapted to foundry and plant use. Depending upon the nature of the work they are to do, the cranes are supplied with a hook and block, grab bucket, electric lifting magnet or excavating equipment as desired.

Operation is by means of an internal combustion engine which is always ready for use. It is not necessary to have a licensed engineer as an operator. Up to the capacity of the engine, any combination of swinging, hoisting or changing the radius is possible. Steering of the crawling tread crane is controlled by manipulation of the friction clutches and brakes which regulate the motion of each tractor belt. By means of these clutches and brakes either of the belts may be disconnected from the engine while the other continues at the same speed. This permits great flexibility in maneuvering. All control levels are conveniently located in the revolving upper works.



MATERIAL HANDLING CRANE WHICH OPERATES FROM INTERNAL COMBUSTION ENGINE

New Dressing for Burns

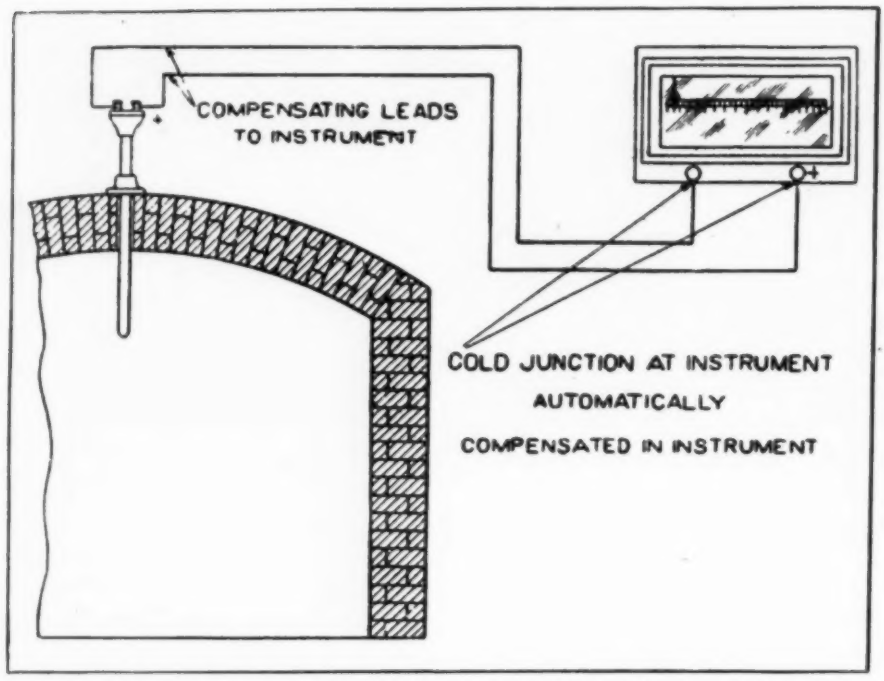
A first aid dressing for serious burns recently has been developed by the Colonial Supply Co., Pittsburgh. It consists of a solution of bicarbonate of soda and mineral oil. A tint of color is added to show liquids.

Three separate rolls of gauze are immersed in this solution and are provided with a little knot at the ends, so as to make extraction easy. The entire affected part of a large burn can be covered quickly. The solution, it is said, does not deteriorate or become rancid and can be kept indefinitely.

The dressing is compounded for use in mines, steel mills, electrical stations, power plants, boiler rooms, foundries, refineries, chemical plants, raliroads, fire departments, schools, hotels, homes, hospitals, boats, garages, doctor's offices and automobiles, or wherever there is a possibility of workmen being burned or scalded.

Develops Compensating Type Pyrometer

A new thermo-electric pyrometer which is automatically compensated in the instrument for changes in cold junction temperatures and which includes means of setting the pointer of the instrument to zero in the usual manner is being placed on the market by the Brown Instrument Co., Philadelphia.



WIRING DIAGRAM OF AN AUTOMATICALLY COMPENSATED PYROMETER

It is generally understood by all users of thermo-electric pyrometers that the millivoltage or electromotive force developed by a thermocouple is dependent on the difference in temperature between the hot and cold ends of a thermocouple. To secure accurate measurements of temperature, it is therefore necessary that the cold end of the thermocouple be maintained at a constant temperature, or the instrument must be compensated for the changes in temperature at the cold junction of the thermocouple.

It is common practice to use what are known as extension or compensating leads, formed of material similar to the thermocouple, which will transfer the cold junction from the binding posts of the thermocouple to a distant point. Heretofore, it has been the custom to locate the cold junction at the end of the extension or compensating leads in a cold well in the ground or in a compensating box, where the temperature can be maintained constant.

In using the new pyrometer compensated for cold junction changes in temperature, it is only necessary to bring the compensating or extension leads from the thermocouple to the instrument. After mounting the instrument, the instrument pointer is set by the zero adjustor to correspond with the index on the scale. If the values for a thermocouple have been determined based on a cold junction of 75 degrees Fahr., the index will indicate 75 degrees Fahr., provided the instrument is subject to this surrounding temperature. If the instrument pointer does not correspond with this index, it is set accordingly. When the temperature surrounding the instrument and the cold junction of the end of the compensating leads at the instrument rises the instrument automatically adjusts itself. Any number of thermocouples with their extensions or compensating leads can be brought to the one instrument having this automatic compensation. The new features of this pyrometer are covered by patents.

Designs Double Eyepiece for Microscope

A stereoscopic eyepiece, recently developed, to be attached to almost any monocular microscope, eliminates eye fatigue since it is not necessary to keep one eye closed or to suppress one image when both eyes are open. This eyepiece, which is manufactured by the Bausch & Lomb Optical Co., Rochester, N. Y., is designed with the eyepiece tubes parallel. This permits the eyes to be used in the natural way, with relaxation from convergence just as if they were directed at a far distant object. The draw tube of the device, shown in the accompanying illustration, is made interchangeable with the monocular eyepieces of most standard microscopes, but with other models a special adapter has been developed.

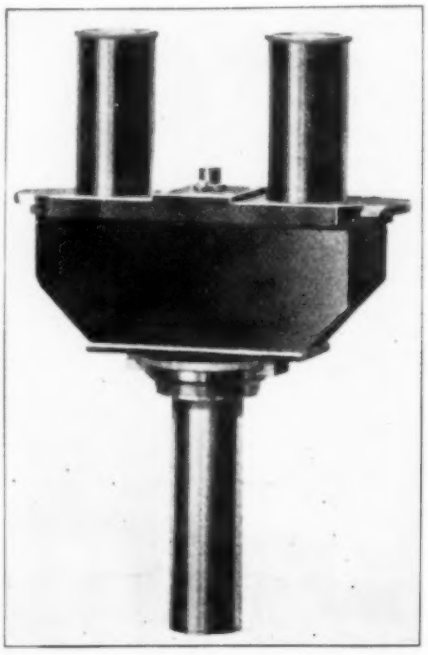
Mounted in the body holding the two parallel eyepiece tubes is a prism system which divides the pencil of light from the objective into two full aperture pencils, turns them through 90 degrees, reflects one and transmits the other. A lens correction is provided to overcome the increased length of the eyepiece over the regular monocular type. On account of the increase in tube length, the objectives give nearly double the ordinary magnifications. Eyepiece caps with semicircular openings enhance the stereoscopic effect. Interpupillary distances of from 50 to 75 millimeters are adjusted by means of a compound numbered slide which separates the eyepiece tubes.

Many Materials Used for Foundry Floors

By H. E. Diller

Question—What would be the best floor for a small jobbing foundry doing light work?

Answer—Three kinds of floors are used. Formerly it was the almost universal custom to place molding sand on the floor one or more feet deep. Some foundries make the floor of cinders, which are packed tight by ramming. More recently cement floors have been adopted by a number of foundries and have given good satisfaction. The advantages are that the floor can be kept cleaner and the sand can be cut easier. Cement floors have the disadvantage of cracking and spalling when hot metal is dropped on them, which makes for expense in their upkeep. For this reason some foundries put cement floors only where metal is not likely to be spilled such as along gangways and make the molding floors, where metal is likely to be spilled, of some other material, such as sand or cinder. Wood block floors have been successful in some instances, particularly in light work shops.



MICROSCOPE EYEPIECE CONSTRUCTED ON STEREOSCOPIC PRINCIPLE

Equipment Buying Improves Slowly

Inquiry Picks Up in All Sections, but Is Characterized by an Emphasized Interest in Prices—Foreign Foundries Give Evidence of Increased Purchases

INCREASED inquiry for foundry equipment is evident in all sections but is accepted as a doubtful measure of business gain. Buying is confined almost entirely to those plants which are so fortunate financially to be able to anticipate future needs and buy on the present low market. Eastern purchases are increasing, particularly from the foundries which expect to participate in the Hudson river vehicular tunnel project. The situation in molding machines, conveying machinery and some classes of lighter equipment grows brighter. The Carley Heater Co., Olean, N. Y., is inquiring for a small jolt machine. The Berkshire Mfg. Co., Cleveland recently received an order from Chemnitz, Germany, the first to emanate from that country since the war.

Pittsburgh District Hopeful

REPORTS coming to sellers of foundry equipment from the Pittsburgh district show tangible evidences of improvement in practically every portion of territory outside of the city itself. One producer of sand cutting machinery reports two or three sizable deals under way in western Pennsylvania which give promise of early closing after having been held in abeyance for about two years. Orders such as these, together with the appearance of what are considered bona fide inquiries, tend to encourage equipment manufacturers. The general belief is that the remainder of September and the month of October will be good from the standpoint of sales. Practically no inquiries are current for molding machines from foundries in or around Pittsburgh, but the Herman Pneumatic Machine Co., Zelienople, Pa., reports a number of deals consummated in the past two or three days which in the aggregate exceed business of the preceding several months. Included are the sale of five large rollover machines to the American Locomotive Works, Schenectady, N. Y.; two large rollover machines to the Marion Machine, Foundry & Supply Co., Marion, Ind., and one machine of similar type to a foundry at Michigan City, Ind. Several new inquiries for molding machines likewise are before this manufacturer. Pittsburgh district foundries are not particularly active as yet and while some are increasing operations to the basis of three or four days weekly, others have shut down entirely. A point brought out by an individual prominently identified with the foundry equipment trade is that during the past several weeks those foundries which are well situated from a financial standpoint have entered the equipment market and taken advantage of the low prices offered. By the time the usual run of foundries will be able to increase their machinery, etc., the law of supply and demand will have begun to work and higher prices will be in vogue. More and more of a tendency is noted to analyze inquiries as they are received. Where the actuating motive back of getting the prices is a real desire to buy, the equipment seller is glad to give it full measure of attention. Some foundries have large pig iron accounts that have to be taken care of before they can purchase needed equipment. As soon as these are out of the way, inquiries will be issued and by and large a heavy fall trade in the equipment field is anticipated. At present the sale of small ladles and flasks is fairly heavy. Foreign buyers of air brakes, air compressors, etc., particularly in the Far East, have been active but the air compressor trade as far as domestic buying is concerned is neglible. Extensions and improvements started at the Dawes & Myler works of the Standard Sanitary Mfg. Co. at New Brighton, Pa., will entail an expenditure of $75,000.

Inquiry Better in the East

SELLERS of foundry equipment in this district report increased volume of inquiry for molding machinery and flasks, indicating that foundries are in receipt of a larger volume of specifications. In fact, there is little doubt of a revival in demand for certain kinds of castings. The possibility of a goodly portion of present demand for equipment materializing into actual business is evident. In the instance of one pipemaker, the Florence Pipe & Machinery Co., Florence, N. J., work on an addition will be started soon. So far as can be learned, no formal inquiry has been issued, but this action is expected shortly. The Vulcan Iron Works, Jersey City, which recently was badly damaged by fire, contemplates replacing its plant. No definite plan, however, has been announced. The situation generally shows little actual improvement in buying. There is a better volume of inquiry, although comprised largely of single machines and sellers are more optimistic than they have been in some time.

Inquiry Brisk, Buying Slow in Chicago

THOUGH many lines of foundry equipment show no increase and at least one foundry equipment manufacturer terms the past four weeks as the worst his company ever has experienced, almost without exception, dealers in the Chicago district find inquiry has quickened materially. On the other hand most of them agree that it is almost impossible to follow up these inquiries and convert them into orders. In some cases they even seem to be idle "shopping" while in others they are simply getting a line on the market in preparation for later buying. The Whiting Corp. recently sold a cupola to a radiator manufacturer and its survey of the situation leads it to believe that industries related to the building trades, those manufacturing heating systems, plumbing and building supplies, are likely to feel the upturn first. The general situation as to actual buying, is exceedingly dull and the demand for small ladles, which usually signalizes resumption of buying, has not yet appeared. Inquiry for molding machines is decidedly better in the experience of several manufacturers and some sales have resulted. Henry E. Pridmore recently closed with an eastern user for two heavy stripping plate machines and this order was followed immediately by another for two machines of the same type to be shipped by express to the same buyer. In molding machines much demand at present apparently comes from the East. A number of small rockover machines have been sold recently in Indiana. The impression is gaining ground that business during the next few months will go in largest volume to foundries best equipped to turn out their products at comparatively low costs. One of the signs of this condition is a quickened inquiry for electric

furnaces. One manufacturer of furnaces has been flooded recently with inquiry, not only from all sections of the United States, but from Japan, South America, Europe and Canada. This foreign inquiry has come so recently it is not possible now to determine its results. The Industrial Electric Furnace Co. recently sold an electric furnace for shipment to Japan. The J. Ryan Foundry Co., Rock Island, Ill., is preparing to build a 2-story foundry. Frank D. Chase, Inc., Chicago, has been commissioned by R. J. Teetor, Muskegon, Mich., to build a foundry at Cadillac. The Vincennes Foundry & Machine Co., Vincennes, Ind., is having plans made for a foundry.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

The Quaker City Iron Works, Philadelphia, contemplates the erection of a plant addition.

The capital stock of the Milwaukee Flush Valve Co., 111 Reservoir street, Milwaukee, recently was increased rom $50,000 to $75,000.

Capitalization of the White Foundry Co., Birmingham, Ala., recently was increased from $10,000 to $20,000.

The Manufacturers' Foundry Co., Waterbury, Conn., has increased its capital stock from $197,250 to $295,875.

Alterations to its foundry are reported under consideration by the Sheffield Foundry Co., 2020 Herndon avenue, Chicago.

Plans are being prepared by the Joseph Toye Co., Bridgeton, N. J., for the erection of a foundry building, 40 x 80 feet.

Architects are drawing plans for the erection of a foundry building, 40 x 100 feet, for the Florence Pipe & Foundry Co., Florence, N. J.

A foundry and machine shop, costing about $100,000, is being erected at Nanticoke, Pa., by J. F. Richards.

Erection of a 2-story plant building is being planned by the J. Ryan Foundry Co., 506 Forty-first street, Rock Island, Ill.

The Jahncke Dry Dock & Ship Repair Co., New Orleans, has acquired the plants of the Crescent City Machine & Mfg. Co., and the Stearn Foundry Co., for extensions to its works.

E. C. Leach, 40 College avenue, San Francisco, is having plans prepared for the erection of a foundry building, to be devoted to the manufacture of iron and other metal castings.

Capitalized at $25,000, the Superior Aluminum Corp., New York, recently was incorporated by S. Brodsky, W. Bichwit, G. C. Woolf and J. L. Bernstein, 3 Beekman street.

The Canadian Brill Co., Ltd., Preston, Ont., is taking over the plant of the Preston Car & Coach Co and will engage in the manufacture of railroad cars, etc.

The Globe Stove & Range Co., Kokomo, Ind., has fired its cupolas in anticipation of beginning operations soon to take care of the increased fall market for its products.

The Unico Motor Products Co., Kansas City, Mo., recently let a contract for the erection of a factory building, 60 x 224 feet, a foundry building, 60 x 160 feet, and other structures.

Heaters will be manufactured in a plant now under construction by the Western Stove Co., Oakland, Cal. J. J. Vaughan is general manager of the company.

The Rich Steel Products Co., Los Angeles, is reported having plans prepared for the erection of a foundry on Santa Fe avenue, and it is said to be in the market for an electric furnace.

Erection of a foundry is being planned by the Ulmer Machinery Co., Porterville, Cal., and it is reported in the market for some general foundry equipmnet.

Capitalized at $50,000, the Roxbury Steel Casting Co., Boston, recently was incorporated by Isaac Edward Sexton and George Adolph Sexton, both of Winchester, Mass., and Perley C. Rogers, of Quincy, Mass.

The Sun Heater Co., Boston, recently was incorporated with a capital stock of $200,000, to manufacture heaters, etc., by Howard J. Bowman, Francis L. Travers and R. L. Travers.

The Mohican Brass & Copper Works, New York, recently was incorporated with a capital stock of $10,000, by E. G. Michaels, E. P. McIntire, J. J. Devitt and C. S. Lorentzen, 68 Broad street.

The Vincennes Foundry & Machine Co., First and Perry streets, Vincennes, Ind., has preliminary plans under way for the erection of a new plant. J. E. Hartegan is president of the company.

Capitalized at $25,000, the Midway Foundry Co., Burlington, N. C., recently was incorporated by W. N. Thompson, S. C. Stanley and J. G. King, and the company is reported having plans prepared for the erection of a plant.

The Easthampton Foundry Co., Easthampton, Mass., is erecting a concrete building, one story, 40 x 50 feet, with 12 x 30-foot and 16 x 19-foot wings, to be used as a foundry. The company's business will be removed from its present quarters at Florence, Mass., in a few weeks.

Articles of incorporation have been filed by the Acme Grey Iron Foundry Co., Milwaukee. The company is capitalized at $25,000, and the incorporators include Warren J. Wheeler and Charles W. Brown. Arthur Breslauer, 120 Wisconsin street, is attorney for the company.

The Neenah Brass Works, Neenah, Wis., has acquired a half interest in the incinerator invention of John B. Ranz, and will start at once to manufacture it in quantities for the market. The device consists largely of gray iron castings.

Brass, bronze and aluminum castings will be manufactured by the Superior Brass Foundry, 316 First street, San Francisco, which recently was organized by C. T. Kraft and others. The company is reported to be in the market for some equipment.

The McCarthy Foundry Co., Inc., 5307-5357 South Lawndale avenue, Chicago, recently was incorporated with a capital stock of $300,000, by John G. Haswell, John J. Carroll, John P. Whelan, M. F. Garland and William E. McCarthy.

Capitalized at $310,000, the New Jersey Die Casting Co., Newark, N. J., recently was incorporated to manufacture die castings, etc., by Gunnar Anderson, A. Roy Myers and James Beakbame, 16 Washington avenue, Irvington, N. J.

The Sterling Brass Co., 4610-12 St. Clair avenue, Cleveland, is holding in a abeyance the erection of its proposed 2-story foundry and machine shop, 145 x 200 feet, to be erected at St. Catherine avenue and Ninety-third street, Cleveland.

The Minerva Engine Co., 1916 East Sixty-first street, Cleveland, has purchased a 10-acre site on which is a plant providing 20,000 square feet of floor space. It is being equipped for the manufacture of engines, etc. G. C. Goby is president of the company and R. L. Long, secretary.

The Kaestner & Hecht Co. recently purchased from A. M. Castle & Co., Chicago, two 7-story buildings formerly occupied by the Union Wire Mattress Co., at the corner of Blackhawk and Cherry streets, Chicago. A new foundry and machine shop is to be built and the property will be used by the new owners for the manufacture of freight and passenger elevators.

Lease of the foundry of the Hardie Mfg. Co., Hudson, Mich., has been taken by the Southern Michigan Brass Foundry Co., Hudson. The brass company was incorporated early this year with $5000 capital stock and has been operating a plant on Center street, Hudson. The company makes brass, bronze and aluminum castings. William O'Brien is president and manager; Richard Allingham is vice president and G. G. Taylor, secretary and treasurer.

New Trade Publications

CRANES.—The Pittsburgh Crane & Equipment Co., Pittsburgh, has published an 8-page bulletin, describing and illustrating electric and handpower traveling cranes and jib cranes. In the bulletin the type H electric trolley is fully described and illustrated. The following features are pointed out: Enclosed gears, short shafts for hoist and trolley travel gearing, no overhung gears, bronze bushed bearings, hoist gearing from motor to drum is one cast frame and the trolley traveling gearing, pyramid type, in one frame.

HEATER.—The American Blower Co., Detroit, has published a 4-page illustrated folder in which a direct-fired unit heater is described and illustrated. This heater consists of a cast iron heat generator installed in a steel insulated casing. An electric motor-driven fan forces air over the warmed surfaces of the heat generator and this heated air is then discharged into the room, or through galvanized ducts to various parts of the building. The heater is described in detail.